AD-A148 423 ACQUISITION STRATEGY GUIDE(U) ARINC RESEARCH CORP ANNAPOLIS MD J R NELSON ET AL. 01 JUL 84 MDA903-82-G-0056 1/2

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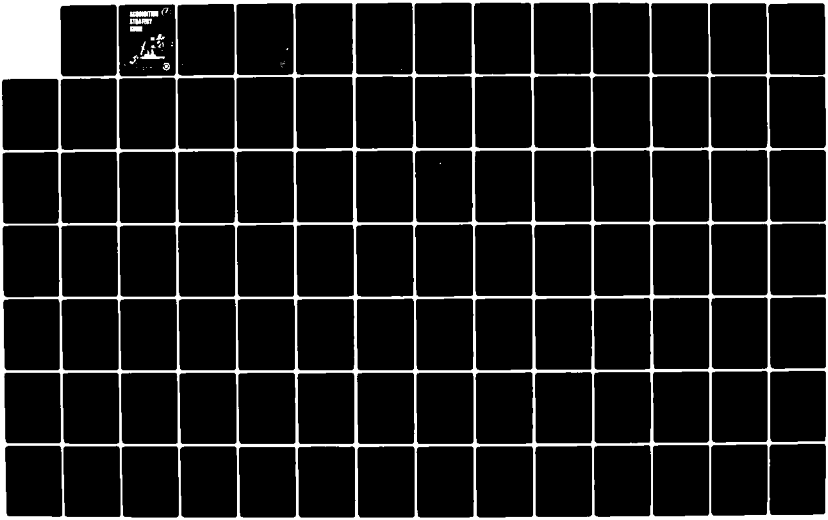

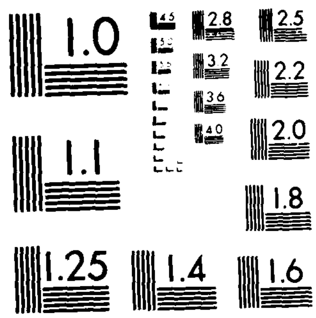

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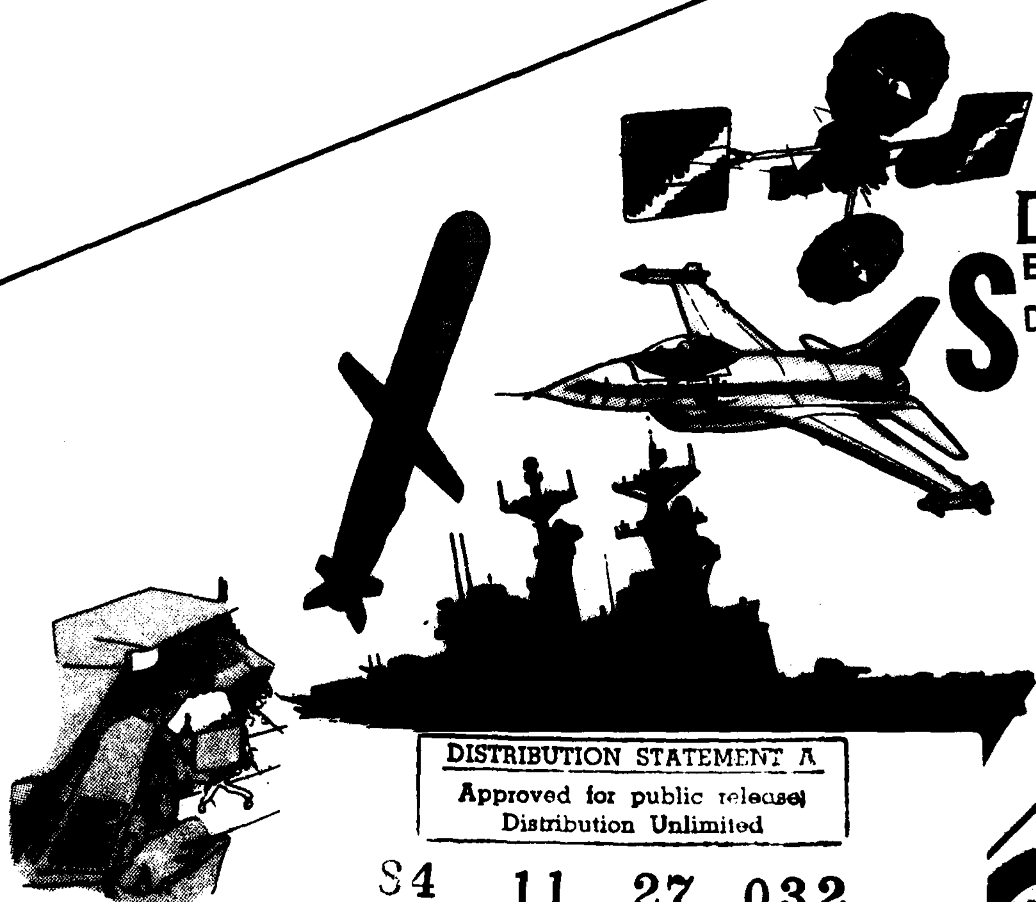

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SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION: UNCLASSIFIED	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT: Unlimited
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION: ARINC Research Corporation; 6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION: Defense Systems Management College
6c. ADDRESS (City, State and ZIP Code): 2551 Riva Road, Annapolis, MD 21401	7b. ADDRESS (City, State and ZIP Code): Fort Belvoir, VA 22060-5426
8a. NAME OF FUNDING/SPONSORING ORGANIZATION; 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER: MDA903-82-G-0056
8c. ADDRESS (City, State and ZIP Code)	10. SOURCE OF FUNDING NOS.

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT NO.
		83-6	

11. TITLE (Include Security Classification): Acquisition Strategy Guide

12. PERSONAL AUTHOR(S): Dr. J. R. Nelson, Dr. Harold S. Balaban

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Yr., Mo., Day)	15. PAGE COUNT
	FROM ____ TO ____	84 July 1	163 plus covers

16. SUPPLEMENTARY NOTATION

17. COSATI CODES		
FIELD	GROUP	SUB. GR.

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number): Acquisition Strategy, Major Systems Acquisition, Acquisition Planning, Program Management Plans, Program Planning

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

Department of Defense policy requires that military Program Managers develop a tailored acquisition strategy that will provide the conceptual basis of the overall plan that a Program Manager follows in program execution. A strategy that is carefully developed and consistently executed is one of the keys to a successful program. It is a difficult and challenging task to blend the multitude of requirements for a major system acquisition into an acquisition strategy that represents a consensus among the organizations that influence or are influenced by the program.

The challenges in developing and executing an acquisition strategy have led to the development of the acquisition strategy guide. The purpose of the guide is to provide the program manager a framework for developing and executing an acquisition strategy. Criteria for evaluating an acquisition strategy are described and developed. Many of the strategy alternatives available to a program manager are described including advantages and disadvantages, application criteria, functional interfaces and recent program experience.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT: UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS ☐	21. ABSTRACT SECURITY CLASSIFICATION
22a. NAME OF RESPONSIBLE INDIVIDUAL	22b. TELEPHONE NUMBER (Include Area Code); 22c. OFFICE SYMBOL

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SECURITY CLASSIFICATION OF THIS PAGE

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ACQUISITION STRATEGY GUIDE

FIRST EDITION
JULY 1984

CONTRACT NUMBER
MDA903-82-G-0056-0001

DEFENSE SYSTEMS MANAGEMENT COLLEGE
FORT BELVOIR, VIRGINIA

PREFACE

Department of Defense policy requires that military Program Managers develop a tailored acquisition strategy that will provide the conceptual basis of the overall plan that a Program Manager follows in program execution. A strategy that is carefully developed and consistently executed is one of the keys to a successful program. It is a difficult and challenging task to blend the multitude of requirements for a major system acquisition into an acquisition strategy that also represents a consensus among the organizations that influence or are influenced by the program.

This Guide provides, in a single source, information that Program Managers should find useful in structuring, developing, and executing an acquisition strategy. It captures many of the successful ideas used in current programs and provides references for additional information to provide assistance to the Program Manager and his staff. A conceptual structure for developing and executing an acquisition strategy is provided together with criteria for evaluating a proposed strategy. The major strategic alternatives available to a Program Manager are presented. For each such alternative there is a discussion of methods, application criteria, advantages and disadvantages, development and analysis approaches, functional interfaces, and recent program experiences. However, this guide alone does not provide the user with a definitive acquisition stategy for his program. Well informed, educated, and innovative applications and judgments are necessary to structure a successful acquisition strategy. Program Managers will continue to seek guidance, data, and assistance from available sources as they prepare and revise their acquisition strategy.

This guide was developed by ARINC Research Corporation, Annapolis, Maryland, under contract MDA903-82-G-0056-0001 directed by DSMC.

Special thanks are due to the many DoD Program Managers and program offices that responded to queries and interviews and to personnel, faculty, and alumni of DSMC whose ideas, suggestions, and comments were helpful in completing this project.

The Defense Systems Management College is the controlling agency for this Guide. Comments and recommendations relating to the text are solicited. You are encouraged to provide them on one of the preaddressed tear sheets located at the back of this Guide and mail them to us.

Leslie R. Swanson
LTC, USAF

Defense Systems Management College
July 1984

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

Today the defense posture of the United States is strong. We have acquired the critical weapon systems needed for our defense. However, acquiring these weapon systems is a complex and challenging process, one that has been subjected to considerable study over several decades. Criticisms of the process in the Department of Defense (DoD) have focused on the acquisition's taking too long, costing too much, and resulting in operational systems that do not perform as expected.

Past and present Administrations and Congresses have taken many initiatives to improve the acquisition of major defense systems, with emphasis on specifying particular acquisition strategies and control methods to make the process more efficient. Examples of strategy include Fly-Before-Buy Prototyping and Total Package Procurement. Examples of control include the Planning, Programming, and Budgeting System (PPBS); Selected Acquisition Reports (SAR); Defense System Acquisition Review Council (DSARC); Cost Analysis Improvement Group (CAIG); and Defense Resources Board (DRB). During the early 1980s, the Acquisition Improvement Program (AIP) in DoD and the Federal Acquisition Regulations (FAR) in the Office of Federal Procurement Policy (OFPP) have emerged. Legislative action has also been evident. For example, the Congress proposed the Defense Procurement Reform Act of 1983 and included a product guarantee requirement in PL98-212, the Defense Appropriations Act of 1984.

These acquisition policy initiatives reach Program Managers in the Military Departments and DoD agencies in the form of DoD Directives and Instructions, which in turn are translated into changes in Military Department and Agency regulations. In 1976, partly as a result of recommendations by the Commission on Government Procurement, the Office of Management and Budget (OMB) issued Circular No. A-109, which established a Government-wide policy to be followed by Executive Branch agencies in the acquisition of major systems. A cornerstone of Circular No. A-109 was the tailoring of an acquisition strategy for new systems development. The OMB policy was translated through DODD 5000.1 and DODI 5000.2 into Military Department regulations (Army AR-1000 and AR 70-1, Navy SECNAVINST 5000.1B and NAVMATINST 5000.29A, Air Force AFR 57-1 and AFR 800-2) that provide overall policy for system acquisition, including acquisition strategy and acquisition planning.

1.2 RECENT DOD GUIDANCE ON DEFINING ACQUISITION STRATEGY

While all services have responded in some measure to the OMB and DoD requirement for acquisition strategy development, there is substantial variation in emphasis on issues, approach to structure and content, and overall guidance. There is no common working definition of "acquisition strategy," or any consistent agreement on its structure and composition; nor is there comprehensive guidance on how to proceed in developing and executing an acquisition strategy.

Acquisition strategy has been defined as a "master plan," "road map," "blueprint," and "plan to plan by"—but perhaps most appropriately as "the conceptual basis of the overall plan that a Program Manager follows in program execution."* It is the framework for planning and directing the program.

*DODI 500.2 Major System Acquisition Procedures, March 19, 1980.

Circular No. A-109 states that an *acquisition strategy should be developed and tailored* "as soon as the agency decides to solicit alternative system design concepts that could lead to the acquisition of a new major system" and, in addition, that steps should be taken to "refine the strategy as the program proceeds through the acquisition process." In the DoD, an acquisition strategy should therefore be developed during Concept Exploration after the program is initiated. The Circular then describes in general terms a variety of considerations that such a strategy might include.

The FAR prescribes policies and procedures for Acquisition Planning (Part 7) and Major System Acquisition (Part 34). DoD policy guidance (DODD 5000.1, DODI 5000.2) specifies that an acquisition strategy shall be developed for each new major system. The Military Departments have responsibility for approving such strategies, and each addresses this requirement in its own way:

- The Army appends an acquisition strategy to each System Concept Paper (SCP). There is guidance on the format and content of an acquisition strategy in AR 70-1 (15 February 1984).
- The Navy issued NAVMATINST 5000.29A (6 May 1983), which details the contents of an Acquisition Strategy Document to be developed and approved early in each new program.
- The Air Force includes elements of an acquisition strategy in the Program Management Plan that is developed by the Program Manager; AFR 800-2 (with AFSC Supplement) provides guidance with respect to the definition of acquisition strategy and responsibilities for its development.

There is considerable variety in the guidance with respect to the format, content, and issues to be addressed. No single information source details the experience and resources that are available to assist Program Managers or higher-level acquisition executives in developing acquisition strategies. Table 1-1 summarizes the major areas to be considered in acquisition planning as presented in key guidance materials at the Federal, DoD, and service levels. A recent example of an Acquisition Plan is included for comparison.

1.3 OBJECTIVES OF THE GUIDE

The objectives of this Acquisition Strategy Guide are as follows:

- To provide a single-source reference document to guide the Program Manager in structuring, developing, and executing an effective acquisition strategy.
- To provide applicable information to policy and staff offices involved in the review and approval process so that there is a common basis for communication.
- To provide a document that can serve as a reference for use in training prospective Program Managers.

1.4 SCOPE AND CONTENTS

This guide focuses on major system acquisition programs, although the basic concepts and principles will apply equally to smaller programs. There are obvious differences, such as the extent of the review process and the number of alternatives available. Throughout the guide, significant differences in service policy and procedures that influence the development of acquisition strategy are noted. This guide is structured to provide an overview of the acquisition process (Chapter Two), the concepts and structure of an acquisition strategy (Chapter Three), the development and execution (Chapter Four), and issues and alternatives (Chapter Five). (Note: Experienced Program Managers might consider proceeding directly to Chapter Three, Acquisition Strategy Concepts and Structure.)

The chapters are summarized briefly as follows:

- Chapter Two, The Defense Acquisition Process, provides an overview of the relationship of defense policy to the acquisition process and identifies participants and their roles. This material should not be new to an experienced Program Manager but serves as a ready reference of the program phases, events, and participants that need to be considered. Military Department organization and procedures are summarized.
- Chapter Three, Acquisition Strategy Concept and Structure, begins the more focused discussion of acquisition strategy. The chapter is designed to ensure that the Program Manager is made aware of the purpose and importance of an acquisition strategy and the conceptual framework for acquisition strategy development and execution. It addresses definition, benefits, timing, concerns, structure and elements, and the criteria of acquisition strategy. Its main purpose, therefore, is to aid the Program Manager in planning for acquisition strategy development.
- Chapter Four, Acquisition Strategy Development and Execution, presents a logical approach to guide the Program Manager in developing and executing strategy. The chapter describes the critical

importance of the acquisition strategy in the overall program management process. It suggests that development, execution, and updating of the acquisition strategy is perhaps the key role of the Program Manager, with the attainment of tactical goals better left to functional assistants. Specific actions required in each acquisition phase are discussed, and the tools that can be used to implement these actions are summarized.

- Chapter Five, Acquisition Strategy Issues and Alternatives, summarizes issues and alternatives *in a consistent* format. The issues are defined; the problem is specified; and approaches, strategy interfaces, time lines, and criteria are described. Advantages and disadvantages of issues and alternatives are compared. Recent experience and sources of information are provided, together with analysis methods and a list of pertinent regulations, directives, and pamphlets.

A bibliography and a list of acronyms and abbreviations are presented in appendixes.

TABLE 1-1

GUIDANCE ON ACQUISITION STRATEGY AND PLANNING

ELEMENTS OF A-109 ACQUISITION STRATEGY	ELEMENTS OF FAR ACQUISITION PLANNING (PART 7)	ELEMENTS OF DAR PROCUREMENT PLANNING (PART 21)	ELEMENTS OF ARMY ACQUISITION STRATEGY (AR 70-1)
- Contracting Process - Scheduling of Essential Elements - Demonstration Test and Evaluation Criteria - Content of Solicitations for Proposals - Decisions On Whom to Solicit - Methods for Obtaining and Sustaining Competitors - Guidelines for Evaluation and Acceptance or Rejection of Proposals - Goals for Design-to-Cost - Methods for Projecting Life-Cycle Costs - Use of Data Rights - Use of Warranties - Methods for Analyzing and Evaluating Contractor and Government Risks - Need for Developing Contractor Incentives - Selection of the Type of Contract Best Suited for Each Stage in the Acquisition Process - Administration of Contracts	Acquisition Background and Objectives - Statement of Need - Applicable Conditions -- Requirements for compatibility with existing or future systems or programs. -- Any known cost, schedule, capability, or performance constraints. - Cost -- Life-cycle cost -- Design-to-cost -- Application of should-cost - Capability or Performance - Delivery or Performance-Period Requirements - Trade-Offs - Risks Plan of Action - Sources - Competition - Source-Selection Procedures - Contracting Considerations - Authority for Contracting by Negotiation - Budgeting and Funding - Product Descriptions - Priorities, Allocations, and Allotments - Contractor Versus Government Performance - Management Information Requirements - Make or Buy - Test and Evaluation - Logistics Considerations -- Assumptions determining contractor or agency support. -- Reliability, maintainability, and quality assurance requirements, including any planned use of warranties. -- Requirements for contractor data (including repurchase data) and data rights, their estimated cost, and the use to be made of the data. - Government-Furnished Property - Government-Furnished Information - Environmental Considerations - Security Considerations - Other Considerations - Milestones for the Acquisition Cycle - Identification of Participants in Acquisition Plan Preparation	- Description of the Program, Item, or System - Program Funding (R&D and Production), Including a Summary of Monies in the FYDP/Budget Submissions - Delivery Requirements, Both R&D and Production Contracts - Applicability of a Decision Coordinating Paper, Program Memorandum, Defense System Acquisition Review Council, or Internal Service Reviews - Background and Procurement History - Discussion of Program Risk, Including Technical, Cost, and Schedule Risk - Integrated Logistics Support Planning Concept - Application of Design-to-Cost - Application of Life-Cycle Cost - Reliability and Maintainability Objective, Including Warranties - Test and Evaluation Approach - Management Information/Program Control Requirements - Approval for Operational Use - Government-Furnished Material/Facilities/Component Breakout - Application of Should-Cost - Milestone Chart Attachment Depicting the Objectives of the Acquisition - Milestones for Updating the Procurement Plan - Identification of Participants in the Procurement Plan Preparation - Procurement Approach for Each Proposed Contract	- Program Structure - Contracting Strategy - Tailoring the Acquisition Process - Supportability - Manufacturing and Production - Test and Evaluation - Cost Growth and Drivers - Technical Risks - Safety and Health

ELEMENTS OF NAVY ACQUISITION STRATEGY (NAVMATINST 5000.29A)	ELEMENTS OF AIR FORCE PROGRAM MANAGEMENT PLAN (AFR 800-2, 3)	ELEMENTS OF RECENT EXAMPLE ACQUISITION PLAN
- Section I: Needs, Constraints, Thresholds, and Program Structure -- Statement of need -- Program constraints and/or thresholds -- Resources and funding -- Program structure - Section II: Risk Analysis - Section III: Strategy to Achieve Objectives and Implementation -- Objectives and goals for the acquisition effort -- Considerations and rationale for program schedule -- Planning and control of critical program activities -- Acquisition alternatives -- The plan for selecting among alternatives and the timing of key selection decisions -- The interdependence of the acquisition effort with other programs -- Risk Management Plan -- The approach for design, hardware data development, and preplanned product improvement (P^3I) -- Plans for achieving reliability in design and manufacturing -- Standardization considerations -- Design-to-cost and affordability considerations -- Integrated logistics support approach -- Use of organizational assets -- Mobilization capability -- A financial strategy -- Plans for and funding required to acquire adequate subsystems and system test hardware -- The business management approach -- An audit trail of key acquisition decisions	- Program Summary and Authorization - Intelligence - Program Management - System Engineering - Test and Evaluation - Communication/Electronics - Operations - Civil Engineering - Logistics - Manpower and Organization - Personnel Training - Security - Directives Application	- Program Description - Program Funding - Delivery Requirements - Applicability of Decision Coordinating Paper (DCP) and Defense Systems Acquisition Review Council (DSARC) Reviews - Background and Acquisition History - Program Risks - Integrated Logistics Support (ILS) Planning - Application of Design-To-Cost (DTC) - Application of Life-Cycle Cost (LCC) - Reliability, Maintainability, and Quality Assurance (R,M&QA) Objectives - Test and Evaluation Approach - Management Information and Program Controls - Approval for Full Production (AFP) - Government-Furnished Property/Facilities/Component Breakout - Should-Cost - Industrial Preparedness Planning - Other Considerations - Acquisition Milestones - Schedule for Updating the Acquisition Plan - Acquisition Plan Participants - Contracting Approach - Long-Range Plan

CHAPTER TWO

THE DEFENSE ACQUISITION PROCESS

2.1 INTRODUCTION

To understand acquisition strategy and place it in proper perspective at the program level, the Program Manager should have an appreciation for the relationship between National Security strategic planning and the acquisition of major defense systems in the context of the defense acquisition environment. The defense acquisition environment is a major influencing factor in selecting the important issues and alternatives of acquisition strategy development for defense programs. Department of Defense and Military Department policies, processes, and participants are important, as is the contribution of industry. The roles, concerns, and possible actions of participants in the Executive and Legislative branches are critical to any program's success. All must receive appropriate attention in the development and execution of an acquisition strategy.

2.2 NATIONAL SECURITY STRATEGIC PLANNING

United States National Security objectives and policies are established by the President. He has advice from the National Security Council, from Cabinet officials such as the Secretary of State and the Secretary of Defense, from the Joint Chiefs of Staff, from Congress, and from other advisors within the administration and throughout the country.

An overview of National Security strategic planning is presented in Figure 2-1. The required overall strategy for accomplishing DoD objectives and policies is developed by DoD/JCS/Military Department officials, who compare strategy options and the existing operational forces' capabilities and resources to determine needs and to establish operational requirements for expansion, modernization, and support of the forces. The process includes analysis of threats, mission area analysis, net assessments of capabilities and shortfalls, conduct of technology programs, and establishment of resource constraints. Programs are initiated and proceed to deployment and operations through the acquisition process.

It is useful, in this context of fitting individual programs into the overall National Security Posture, to distinguish between the macro-strategy of acquiring forces for National Security Objectives at the highest levels in the Administration and the micro-strategy of acquiring a particular system through the conduct of a program. The Program Manager is directly involved at the micro-acquisition strategy level but must certainly be aware of the broader issues. The Program Manager's domain is shown in the figure. Program execution and resource expenditure within the program acquisition process are certainly major concerns, but translating the operational requirements into operating forces is the primary objective. The operating forces feed back to the macro-strategy to match the threat and to determine if the National objectives and policies can be accomplished. New operational requirements may be necessary. Technologies are assessed to identify feasible and realizable developments that may be incorporated into weapons systems. Mission area analyses are performed to identify deficiencies in existing agency capabilities, or to evaluate opportunities for establishing new technological capabilities. Force planning employs net assessment to determine shortfalls in matching the threat and in assessing potential risks due to technological accomplishments by adversaries. If necessary, programs and resources are adjusted to achieve a more desirable balance of operating forces capabilities.

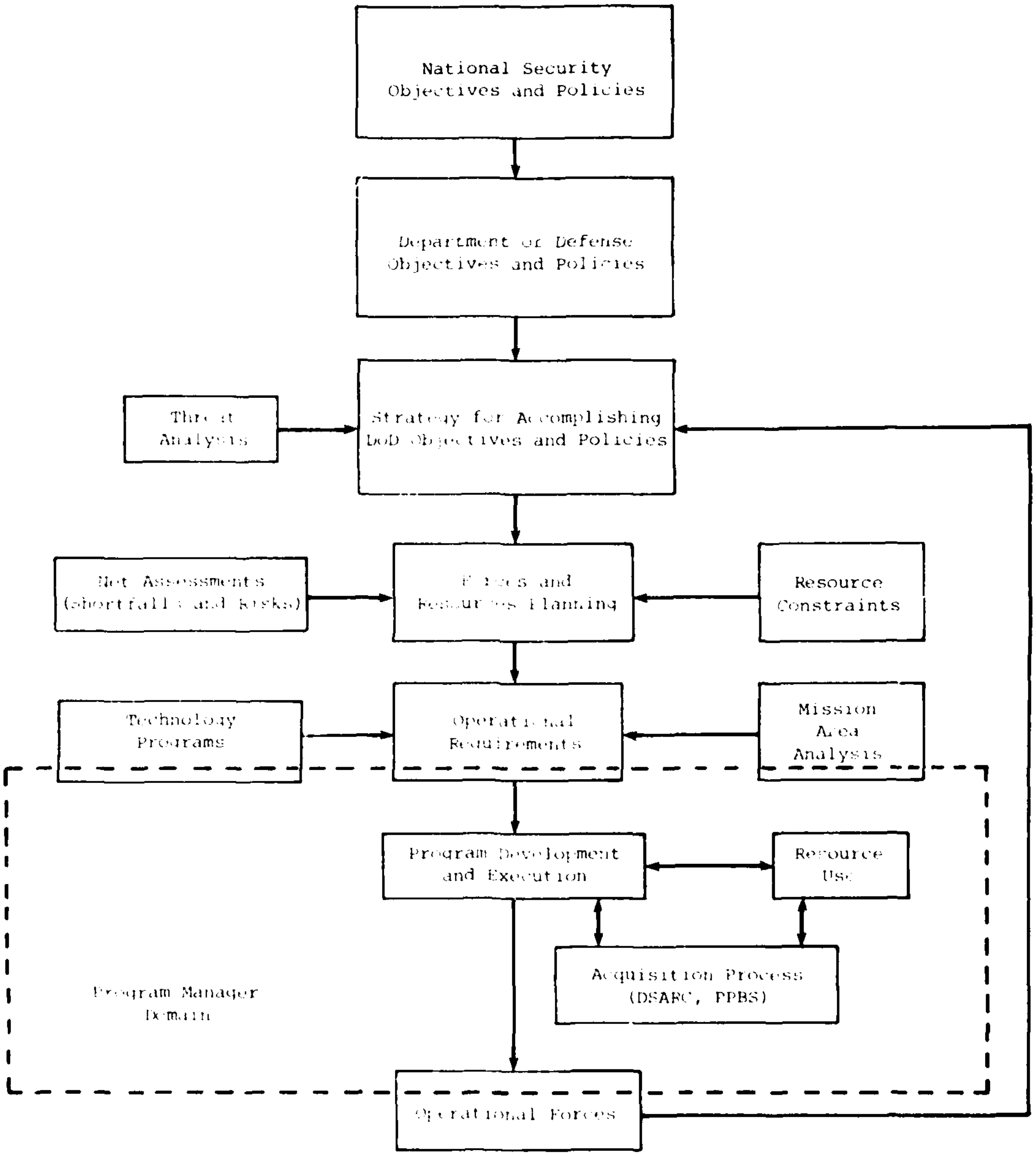

FIGURE 2-1

OVERVIEW OF NATIONAL SECURITY STRATEGIC PLANNING

Acquisition is accomplished through consideration of priorities and pertinent resource and schedule constraints. The programs and resources are matched in acquiring major defense weapons by means of two well established processes: (1) the Defense Systems Acquisition Review Council (DSARC) and (2) the Planning, Programming, and Budget System (PPBS). The former is the approval process for programs; the latter translates requirements and resulting plans and programs into operating forces' hardware and software and provides the resources to support the operating forces.

2.3 DEFENSE SYSTEM ACQUISITION PARTICIPANTS

The President has at his disposal the advice of many individuals, agencies, and organizations, inside and outside the Federal Government. His principal office within the White House Staff for National Security policies and objectives is the National Security Council. For the defense systems acquisition process and decisions about resources, he has the Office of Management and Budget (OMB). They interact directly with the Department of Defense, the principal architect and implementer of macro-acquisition strategy for expansion, modernization, and support of forces to carry out Presidential policy and objectives. Defense system micro-acquisition strategy is developed by the Military Department (or Departments in the case of joint programs and in conjunction with foreign countries in the case of multinational programs), with responsibility delegated to a Program Manager to conduct a specific program. The Military Departments, working in conjunction with the OSD staff, are responsible for bringing programs to fruition and for meeting technical, schedule, and cost goals.

Congress authorizes and appropriates the money for programs. In recent years Congress has become much more directly involved with the technical details of the acquisition process. Congress has been adding to authorization and appropriation bills specific constraints and objectives related to certain weapon systems programs. Industry implements the Administration's desires to develop and manufacture new systems through contractual relationships with the specific Military Department that has responsibility for a program. Table 2-1 lists the defense systems acquisition participants and notes sources of policy guidelines and decision responsibilities.

The relationships among the acquisition participants are very complex, and it is critical to a program for the Program Manager to be aware of people and policies that have an impact on this program. Many participants in the acquisition process have veto power or can present obstacles to the Program Manager; few have approval authority. The Program Manager must try to satisfy all elements in the approval chain.

The participants are not always in agreement. In some instances the Executive Branch (through the Department of Defense and a Military Department) advocates a particular program but part of the Congress is opposed to it. A case in point is the MX missile development. In other instances the Administration and Congress agree on what to do but industry exerts what influence it has with particular Congressional members to obtain certain favorable decisions. The C-5B/C-17 decision is an example. Sometimes the military and the Department of Defense no longer advocate procurement of a system and Congress dictates further procurement, as in the case of the last purchases of the A-7D aircraft for the Air Force. Congress has become more directly involved in program technical requirements, as when it imposed a weight restriction on the new USAF small ICBM. There also has been conflicting direction, as when the House and Senate split on the need for a second production source for the M-1 Tank engine. Table 2-2 highlights recent trends (as of 1984) that have the following effects:

- Continue centralized policy direction at the OSD level, while delegating more authority and responsibility to the services in terms of detailed programming and execution, as evidenced by DoD's deferring several milestone decisions to the service.
- Strengthen the roles of operational commanders and the Joint Staff.
- Strengthen the planning phase by providing guidance in developing programs and budgets.

Each of the participants also has an oversight capability that is exercised to ensure that laws and regulations are being observed and programs are being pursued efficiently. There are a number of oversight and monitoring agencies. The Executive Branch has the Justice Department and OMB; the Department of Defense and the Military Departments have independent Inspector General functions; and Congress operates the General Accounting Office for program audits and assessments, the Congressional Budget Office for budget and program cost estimates, and the Congressional Research Service and Office of Technology Assessment for studies and analyses. Industry has its legal resources to protect its interests. The Program Manager must be sensitive to all of these participants' positions and their vested interests.

TABLE 2-1

DEFENSE SYSTEMS ACQUISITION PARTICIPANTS*

Organization	Policy Guidelines	Decision Responsibility	Implementation
Executive Branch	A109 FAR	OMB/DoD	President's Budget
Department of Defense	5000.1 5000.2 DAR/FAR	DoD/DRB	DSARC PPBS
Military Department	A (1000 series) N/MC (5000 series) AF (800 series)	A SA N/MC SECNAV AF SAF	(S)SARC PPBS/POM
Congress	Budget Impoundment and Control Act	HASC/SASC HBC/SBC HAC/SAC, et al.	Authorization and Appropriation Legislation
Industry	DAR/FAR	Corporate Executive	Contract

*See the list of acronyms in Appendix A.

2.4 THE ACQUISITION PROCESS AND ENVIRONMENT

There are two major processes in the acquisition environment: (1) Planning, Programming, and Budgeting System (PPBS); and (2) Defense System Acquisition Review Council (DSARC) and Military Department review [(S)SARC]. Both processes have evolved over the past several decades. There have been a number of changes to the PPBS process since its inception during the Kennedy Administration in the early 1960s, and to the DSARC process since it was initiated by Deputy Secretary of Defense David Packard during the Nixon Administration in the late 1960s. One of the greatest sources of change is change of Administration. Each new Administration tends to adjust these processes to its own style of management.

2.4.1 Planning, Programming, and Budgeting System

The Planning, Programming, and Budgeting System (PPBS) is the strategic planning and resources management system in the Department of Defense. Employed to its fullest extent, it identifies mission needs; matches needs with resource requirements; and translates them into budget proposals and, finally, into programs. The inputs to the process are the JCS and Military Department planning documents, the Military Department Program Objective Memoranda (POMs), and budget estimates. The system outputs include the Defense Guidance to the Military Departments, which provides guidelines to the services concerning budgets and programs; the Five-Year Defense Program (FYDP); and, finally, the DoD portion of the President's budget. Congress receives the budget in January and has the responsibility to authorize and appropriate funds for the fiscal year beginning in October. Figure 2-2 depicts the events and the timing of those events within the overall PPBS system. It takes more than three years for a single fiscal year's detailed plan and budget to go through the entire process. At any given time, four PPBS cycles are under consideration, as shown in Figure 2-3. It takes even longer if out-year budgeting in the FYDP is included.

TABLE 2-2 RECENT TRENDS AFFECTING ACQUISITION STRATEGY DEVELOPMENT
Administration
- Increasing budget - Increasing forces and increased ability to project force into world trouble spots
DoD
- Decentralization toward increasing Military Department authority and responsibility - Improving and modernizing the defense industrial base - Increasing competition - Decreasing acquisition time - Increasing oversight in the area of competition
Services
- More authority and responsibility in initiating early system definition work (concept exploration) - More authority and responsibility in approving programs for full production and deployment
Industry
- Improving profits - Increasing productivity - Improving production base
Congress
- Closer, more detailed program and budget reviews - More initiatives and constraints in authorization and appropriation bills

National policy and Department of Defense guidance are provided to the services when they develop their POMs. Program Decision Memoranda result from DoD reviews, with the services then adjusting their budgets to those decisions in time for the President's budget message to Congress in January. The Defense Resources Board (DRB) is the DoD corporate review body that assists the Secretary of Defense in the PPBS process.

In the three phases of planning, programming, and budgeting, (1) planning outputs are used to determine total forces required to counter the threat, establish critical needs, and guide resource decisions; (2) programming matches available dollars to the most critical needs, leading to the development of the five-year resource proposal; and (3) budgeting provides final costs for approved programs and a detailed budget for submittal to the Congress. Congress enacts the budget into law after a period of hearings and debates concerning the magnitude of the resource requirements and particular programs of interest. DoD executes its fiscal year budget after the President signs it into law.

2.4.2 DSARC and Military Department Review

The present acquisition process in the Department of Defense is a direct result of the efforts by Deputy

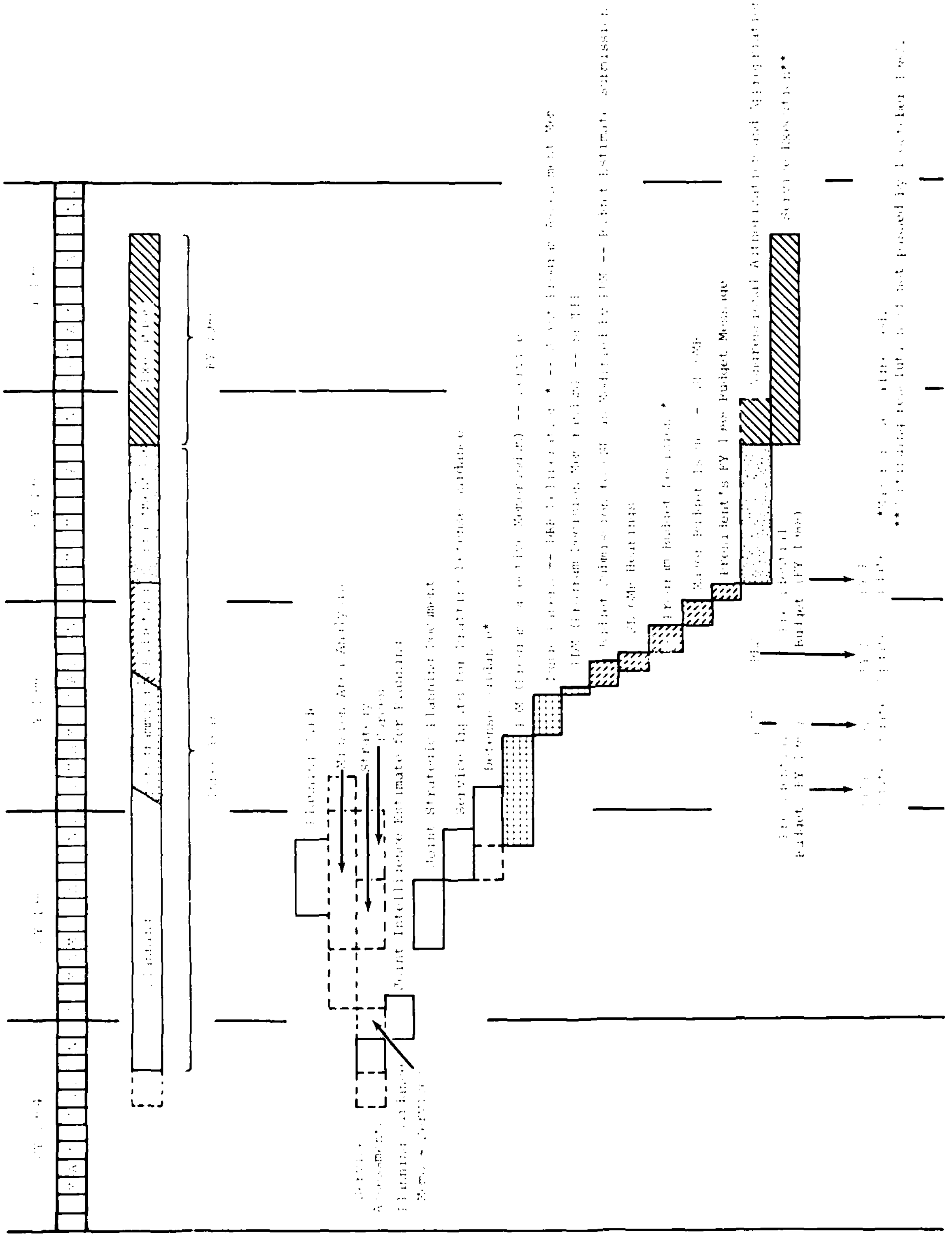

FIGURE 2-2

THE FY 1988 DEFENSE BUDGET: A SINGLE PLANNING, PROGRAMMING, AND BUDGETING CYCLE

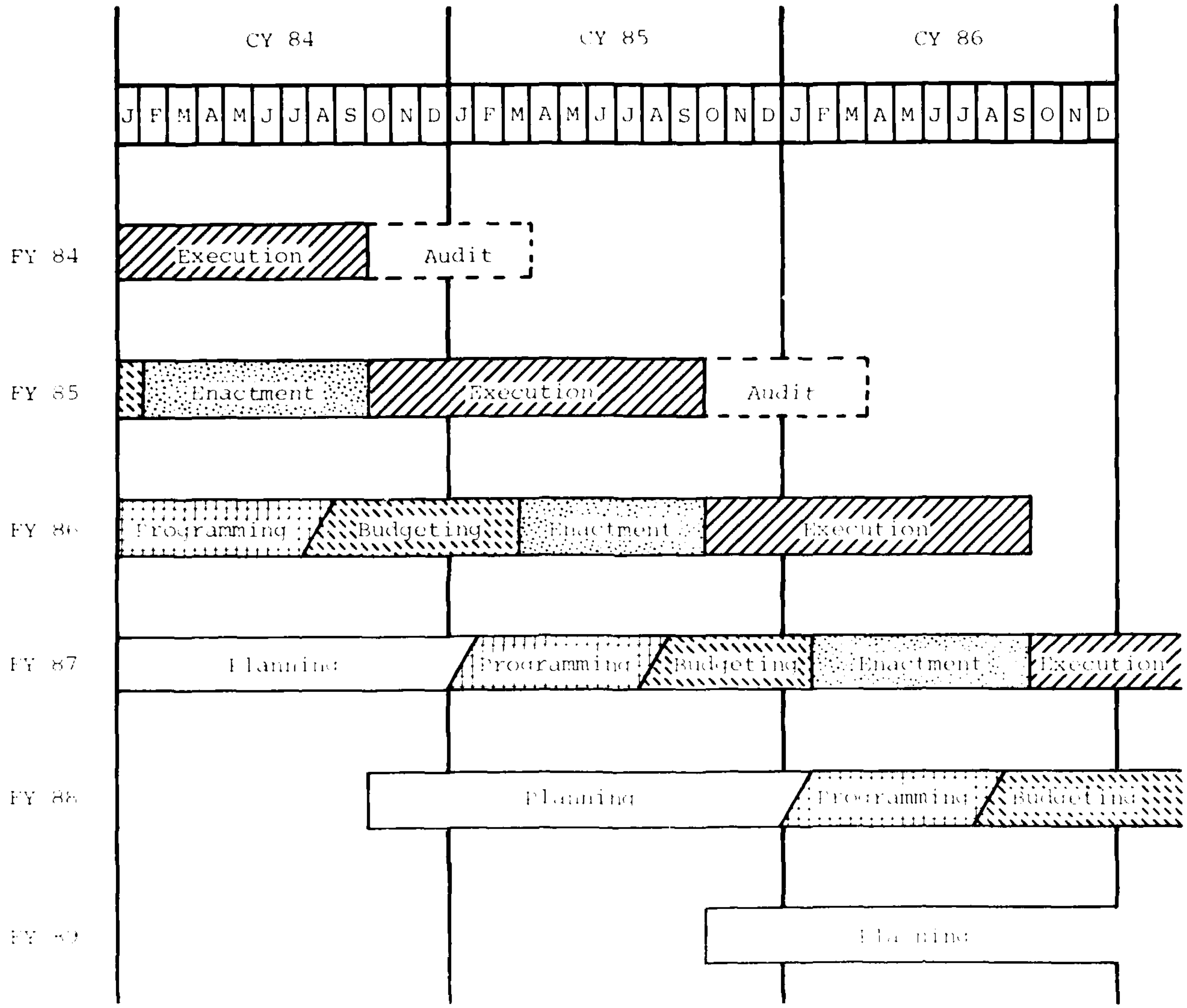

FIGURE 2-3

FOUR CONCURRENT PPBS CYCLES

		Mission Need Determination		DSARC I Concept Selection	
Acquisition Phase	Mission Feasibility		Concept Exploration (Competitive Contractor Studies)		Demonstration and Validation (Competitive Efforts by Contractors)
Decision		PDM		SDDM	
Documentation		JMSNS With Service POM		. SCP . TEMP	
			Develop Acquisition Strategy	Prepare SCP/TEMP	Execute and Modify Acquisition Strategy
Activities	- Technology Advancement - LCC Assessment - Mission Feasibility and Utility Analysis		- Proposal Review and Contractor Selection - System Requirements Review - Trade Studies - Mission Requirements - System Requirements Definition/ Specification - Requirement Allocation - Operational Concept Trades - System Functional Concept Trades - Technology/Risk Assessment - Interface Definition - LCC Assessment - Logistics Supportability - Functional Baseline Development		- Proposal Review and Contractor Selection - System Requirements Review - Trade Studies - System Allocated Baseline Definition and Element Specifications - Performance/Cost/Schedule Refinement - Update LCC - Logistics Support Validation - Interface Agreements and Specifications - System Integration Plans - Configuration Management Program Defined - Risk Planning/Management - Production Capability Assessment - PEP - Developmental/Operational Testing Coordination Assessment - System Design Review - SEMP Preparation

Terms

JMSNS	- Justification for Major System New Start
POM	- Program Objectives Memorandum
SCP	- System Concept Paper
TEMP	- Test and Evaluation Master Plan
SEMP	- System Engineering Master Plan
FQR	- Formal Qualification Review
FCA	- Functional Configuration Audit
DCP/IPS	- Decision Coordinating Paper/ Integrated Program Summary
ILS	- Integrated Logistics Support
SDDM	- Secretary of Defense Decision Memorandum
PDM	- Program Decision Memorandum
PEP	- [illegible]

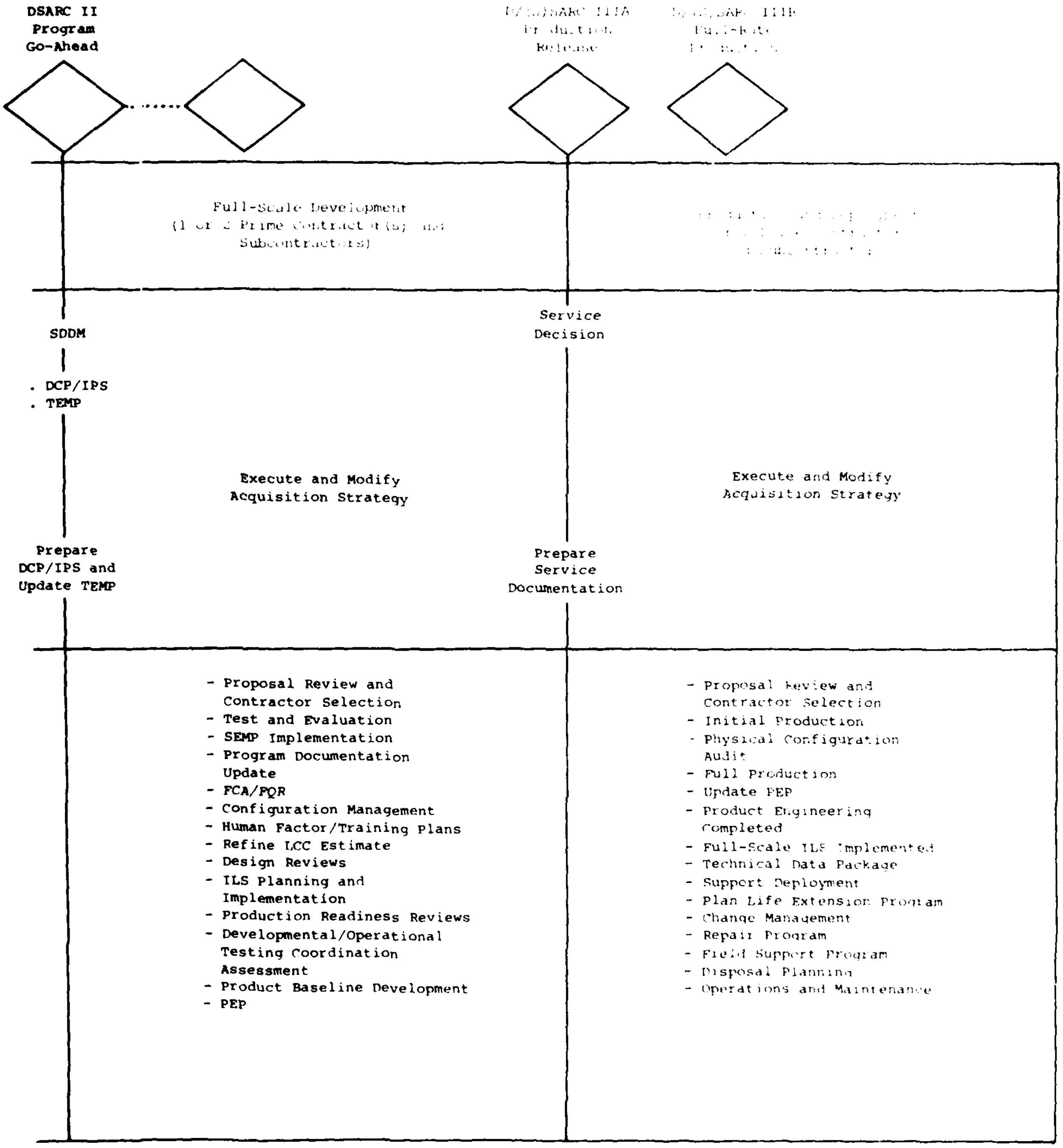

FIGURE 2-4

MAJOR DEFENSE SYSTEMS ACQUISITION PROCESS

Secretary of Defense Packard during the early 1970s to improve DoD acquisition policy through the issuance of DoD Directive 5000.1 and associated instructions in the 5000 series that followed. The philosophy behind this effort was that successful development, production, and deployment of major defense systems are primarily dependent on competent people, rational priorities, and clearly defined responsibilities.

The Office of the Secretary of Defense was given responsibility for establishing acquisition policy that assured that major programs were being pursued in response to specific needs and in a manner consistent with good management practices. The DoD Military Departments and Defense Agencies were given responsibility for identifying those needs and defining, developing, and producing systems to satisfy those needs. As part of the process, a Defense System Acquisition Review Council (DSARC) was established to review programs and make recommendations to SECDEF on how the program should proceed, and certain documents were identified as containing key requirements. Over the years the principal documents that have emerged are the Justification for Major System New Start (JMSNS), in which Part VI briefly addresses an initial acquisition strategy; the System Concept Paper (SCP) promulgated at Milestone I Concept Selection (prior to Demonstration and Validation); and the Decision Coordinating Paper (DCP) and Integrated Program Summary (IPS), which are promulgated at Milestone II Program Go-Ahead (approval to proceed with Full Scale Development and then into Production). The Secretary of Defense Decision Memorandum (SDDM) is the official response at both milestones.

Figure 2-4 presents the acquisition process, showing the different phases and activities and the milestone dates accompanying the phases. Currently, the services submit a Justification for Major System New Start (JMSNS) in the POM. A preliminary acquisition strategy is part of the JMSNS. Approval of the POM in the Five-Year Defense Program (FYDP) allows the program to proceed with Concept Exploration in the Military Department. Milestone I is the DSARC decision point for program initiation of Demonstration and Validation. A System Concept Paper (SCP) must be submitted by the Military Department at this decision milestone. An acquisition strategy should have been developed by this point. In Demonstration and Validation, prototype hardware may be developed and tested and a concept for achieving the operational need is selected. At Milestone II, the DSARC decision is made to proceed through Full Scale Development and, by implication, to continue the program into Production and Deployment. The Milestone II date is flexible in that it can occur before the signing of Full Scale Development contracts or after the beginning of FSD, coinciding with system Preliminary Design Review. At Milestone III, as program development goals are achieved, the Military Department can make the decision to proceed to Production and Deployment. It has the responsibility for determining that the system is ready for high-rate production and for deployment to the operating forces.

Each of the Military Departments has established a process, similar to the DSARC process, for managing the decision activities associated with the system acquisition. Tables 2-3 through 2-6 summarize Army, Navy, Marine Corps, and Air Force acquisition management functions and organizations.

TABLE 2-3

ARMY SYSTEM ACQUISITION PROCESS: FUNCTIONS AND ORGANIZATIONS

Function	Organization
Service Acquisition Executive	ASA (RD&A)
(S)SARC Chairman	Vice Chief of Staff
(S)SARC Members (Per Regulation)	Under-Sec. Army; ASA (RD&A); ASA (IL&FM); ASA (M&RA); DUSA (OR); GEN COUNSEL; CG DARCOM; CG TRADOC; CG OTEA; DCS/RDA; DCS/OPS; DCS/PER; DCS/LOG; Comptroller; Director PA&E; ACS/INTEL; and others
Executive Secretary	
Principal Military Dept., Service Hq. Staff Level, and Major Command Staff Level Focal Points	Dept. of Army System Coordinator (DASC)-(DSC/RDA)
	Force Integration Staff Officer (FISO)-(DCS/OPS)
	Weapon System Staff Manager (WSSM)-(DARCOM)
	TRADOC System Manager (TSM)-(TRADOC)
Principal Operational Requirements Documents	LOA - Letter of Agreement ROC - Required Operational Capability LR - Letter Requirement JMSNS - Justification for Major System New Start
JMSNS Preparation	TRADOC
Principal Management Review Mechanisms	Command Review - (DARCOM Level) IPR - In-Process Review (DCS/RDA and DARCOM levels Program Review - (HQ DA level) ASARC - (HQ DA level) DSARC
MIL Dept. Level	
- POM Preparation	Director, PA&E Comptroller
- Budget Preparation	Comptroller (DIR, Army Budget)
Principal Commands/ Organizations for	
- Independent T&E	OTEA
- User Representation	TRADOC
- Development and Acquisition	DARCOM
- Logistics Support	DARCOM
Guidance and Regulations	AR 1000-1; AR 70-1; AR 70-27

TABLE 2-4

NAVY SYSTEM ACQUISITION PROCESS: FUNCTIONS AND ORGANIZATIONS

Function	Organization
Service Acquisition Executive	ASN (RE&S) - All Acquisition Programs except Ship/Ship conversion up to full scale production decision ASN (SB&L) - Ship/Ship conversion throughout life cycle and all acquisition programs after Full Scale Production decision
(S)SARC Chairman	Cognizant ASN - Either ASN (RE&S) or ASN (SB&L) - See above
(S)SARC Members (Per Regulation)	SECNAV; UNDERSECNAV; ASN (RE&S); ASN (M&RA); ASN (SB&L): CNO; COMMANDANT-USMC; DUSN/FM; Chief, Naval Material
Executive Secretary	Director, Office of Program Appraisal
Principal Military Dept., Service Hq. Staff Level, and Major Command Staff Level Focal Points	Program Coordinator (PC) - OPNAV DCNOs for Warfare Spe ialties Development Coordinator (DC) - OPNAV Director, RDT&E, if R&D funds are involved
Principal Operational Requirements Documents	OR - Operation Requirement JMSNS - Justification for Major System New Start
JMSNS Preparation	OPNAV
Principal Management Review Mechanisms	ARB - Acquisition Review Board (SYSCOM Level) LRG - Logistic Review Group (NAVMAT Level) ARC - Acquisition Review Committee (OPNAV Level) CEB - CNO Executive Board (OPNAV Level) SAIP - Ship Acquisition Improvement Panel (OPNAV Level) DNSARC - (Navy Dept. Level) DSARC
MIL Dept. Level	
- POM and Budget	Director, Program Planning (OP-090) Preparation
Principal Commands/ Organizations for	
- Independent T&E - User Representation - Development and Acquisition - Logistics Support	OPTEVFOR OPNAV NAVMAT NAVMAT
Guidance and Regulations	SECNAV 5000.1B; NAVMAT 5000.29A

TABLE 2-5

MARINE CORPS SYSTEM ACQUISITION PROCESS: FUNCTIONS AND ORGANIZATIONS

Function	Organization
Service Acquisition Executive	Assistant CMC/Chief of Staff assisted by: DCS, RD&S (during RDT&E phase); DCS, I&L (during production and O&S phases)
(S)SARC Chairman	Asst. CMC/Chief of Staff
(S)SARC Members (Per Regulation)	DCS/Plans, Policies, & Operations; DCS/Requirements & Programs; DCS/Manpower; DCS/Install & Log; DCS/Aviation; DCS/RD&S; DCS/Reserve Affairs; Director, C^3 and Computer Systems Division; Director, Intelligence Division; Director, Training Division; Fiscal Director; CG, MCDEC
Executive Secretary	DCS/RD&S
Principal Military Dept. Service Hq. Staff Level and Major Command Staff Level Focal Points	ACQ Sponsor Project Officer (ASPO) (Located at HQMC)
Principal Operational Requirements Documents	ROC - Required Operational Capability (MCDEC prepared) JMSNS - Justification for Major System New Start
JMSNS Preparation	Acquisition Program Sponsor
Principal Management Review Mechanisms	IPR - In Progress Review Committee (HQ MC Level) MSARC (HQ MC Level)
MIL Dept. Level	
- POM Preparation	DCS, Requirements and Programs
- Budget Preparation	Fiscal Director
Principal Commands/ Organizations for	
- Independent T&E	MCOTEA
- User Representation	Operational Commands
- Development	MCDEC
- Acquisition and Logistics Support	DCS/I&L
Guidance and Regulations	SECNAV 5000.1B; NAVMAT 5000.29A

TABLE 2-6

AIR FORCE SYSTEM ACQUISITION PROCESS: FUNCTIONS AND ORGANIZATIONS

Function	Organization
Service Acquisition Executive	ASAF (RD&L) or ASAF (AFDAP)
(S)SARC Chairman	ASAF (RD&L)
(S)SARC (Per Regulation)	ASAF (FM); ASAF (MRA&I); VICE CS; Comptroller; DCS/Programs & Resources; DCS/RD&A; DCS/Log & Engr.; DCS/Operations, Plans & Readiness; DCS/Manpower & Personnel; General Counsel (Advisor); Asst. C/S Studies & Analyses (Advisor); AFOTEC (Advisor)
Executive Secretary	DEP ASAF/ACQ and LOG Policy
Principal Military Dept. Service Hq. Staff Level and Major Command Staff Level Focal Point	Program Element Monitor (PEM) Air Staff (some are located at HQ AFSC) Systems Officer (SYSTO)-AFSC
Principal Operational Requirements Documents	SON - Statement of Need JMSNS - Justification for Major System New Start
JMSNS Preparation	DCS/OPS, Plans and Readiness
Principal Review Mechanisms	MAR - Management Assessment Review (Product DIV Level) CAR - Command Assessment Review (AFSC Level) PAR - Program Assessment Review (HQ USAF Level) SPR - Secretarial Program Review (SAF Level) AF Board Structure (Air Staff Level) AFSARC - (SAF Level) DSARC
MIL Department Level	
- POM Preparation - Budget Preparation	DCS, Programs and Resources Comptroller (Dir., Air Force Budget)
Principal Commands/ Organizations for	
- Independent T&E - User Representation - Development and Acquisition - Logistics Support	AFOTEC Operational Commands AFSC AFLC
Guidance and Regulations	AFR 57-1; AFR 800-2/3

CHAPTER THREE

ACQUISITION STRATEGY CONCEPTS AND STRUCTURE

3.1 INTRODUCTION

What is an acquisition strategy? Why is it important to develop an acquisition strategy as early as possible in the life cycle of a new system? What are the structure and composition of an acquisition strategy? What are the desirable characteristics of an acquisition strategy?

This chapter addresses the "what?" "why?" and "when?" questions. It defines acquisition strategy, describes its benefits, and details its structure and characteristics. Chapter Four will address "how?" "who?" and "where?": the development, execution, and modification of acquisition strategy. Chapter Five will present specific alternatives in "tailoring" an acquisition strategy to a particular program's requirements and objectives.

3.2 DEFINITION

The acquisition strategy for obtaining a new weapon system to satisfy an approved mission need is "the conceptual basis of the overall plan that a Program Manager follows in program execution."* However, a specific framework is needed for planning, directing, and managing the program. The acquisition strategy encompasses program objectives, direction, and control through the integration of *strategic, technical,* and *resource* concerns. Ideally, the acquisition strategy is structured at the outset of the program to provide an organized and consistent approach to meeting program objectives within known constraints. It is modified as more information is acquired. It can be characterized by the degree to which it is *realistically* tailored to these program objectives and constraints but is *flexible* enough to allow innovation and modification as the program evolves. It *balances* cost-effectiveness through development of technological options, exploration of design concepts, and planning and conduct of acquisition activities directed toward a planned Initial Operational Capability, while adhering to a program budget. The strategy should be structured to achieve program *stability* by minimizing technical, schedule, and cost *risks.* Thus the criteria of realism, stability, balance, flexibility, and controlled risk can be used to guide the development and execution of an acquisition strategy and to evaluate its potential effectiveness.

*DODI 5000.2 Major System Acquisition Procedures, March 19, 1980.

3.3 BENEFITS

Successful program management requires the continuing actions of planning, organizing, directing, coordinating, controlling, and evaluating the use of money, materials, staff, contractors, and facilities to achieve program objectives within constraints placed on the program. A sound acquisition strategy is required for the Program Manager to meet program objectives.

The Program Manager benefits from efforts to develop and execute a sensible, comprehensive, yet tailored acquisition strategy. The benefits are described in Sections 3.3.1 through 3.3.5.

3.3.1 Providing an Organized and Consistent Approach

The acquisition strategy can serve as a master check list: ensuring that all important issues and alternatives are considered, yet recognizing that each program requires a tailored acquisition strategy addressing each phase of the life cycle. At any point in the

acquisition process, the strategy not only must concentrate on the next phase in terms of what the Program Manager is learning now but also must address the remaining life of the program.

Inadequate strategic planning in the beginning and throughout the program leads to increased diversions from program objectives, causing potential cost, schedule, and technical problems during subsequent cycle phases. Poor planning at the outset can result in an inability to reconcile and accomplish competing program objectives.

3.3.2 Permitting Informed and Timely Decisions

The primary purpose of an acquisition strategy is to prioritize and integrate many diverse functional requirements, to evaluate and select from among the important issue alternatives, to identify the opportunities and times for critical decisions (decision windows), and to provide a coordinated approach to achieving program objectives economically and effectively. Each program acquisition strategy is thus developed on a case-by-case basis, with the acquisition strategy being used as a "road map" for program planning and execution. Information obtained during conduct of the program is used to adjust the acquisition strategy as necessary.

3.3.3 Achieving Agreement on the Program

The acquisition strategy serves as the baseline for preparing the plans and activities to accomplish the program. The acquisition strategy can become a contract between the Program Manager and Military Department head (and others, e.g., user, developer, supporter, tester, trainer) for achieving the program's objectives and goals, and for tailoring acquisition alternatives that are expected to be followed. It is the basis from which all functional planning proceeds.

3.3.4 Providing Communication About the Program

The acquisition strategy documents the ground rules and assumptions under which the program was undertaken. It guides and documents progress achieved as it is updated and therefore provides a documented audit trail for succeeding Program Managers. It also provides an agreed-upon standard by which higher headquarters can measure program progress while maintaining the maximum possible delegation of authority to the Program Manager.

3.3.5 Building Advocacy and Support

When the acquisition strategy is reviewed and approved, a credible, realistic approach to the conduct of the program can be established and advocated from the Military Department up through OSD to the White House and Congress. The acquisition strategy can be the vehicle for building a consensus that the developed approach is the best for acquiring and deploying the system or equipment.

3.4 TIMING

The acquisition strategy should be developed as early in the life cycle as possible. Figure 3-1 shows the impact of decisions on life-cycle costs relative to actual expenditures. This figure suggests that the scope of the program funding is substantially determined prior to Full Scale Development; thus the importance of early but careful decisions. An acquisition strategy should be developed by a date no later than the DSARC I milestone and updated periodically. For existing programs that do not have a formal acquisition strategy, it could still be helpful to develop one for the remainder of the program.

3.5 ACQUISITION STRATEGY STRUCTURE

In developing the acquisition strategy, Program Managers must recognize the areas of concern and know the options or alternatives available for addressing them. Figure 3-2 is an overview of the conceptual basis for acquisition strategy development. There are three major areas of concern:

- Strategic
- Technical
- Resource

As shown in Figure 3-2, there are a number of strategic and functional elements that must be considered. In the acquisition strategy development it is necessary to identify those elements which are critical to the program and select alternatives and decision time intervals (windows) that meet program objectives and strategy criteria.

This set of alternatives and windows is the acquisition strategy, which provides the direction for the development of functional plans such as the PEP, TEMP, or ILSP. These plans provide the direction and control for program execution. This section

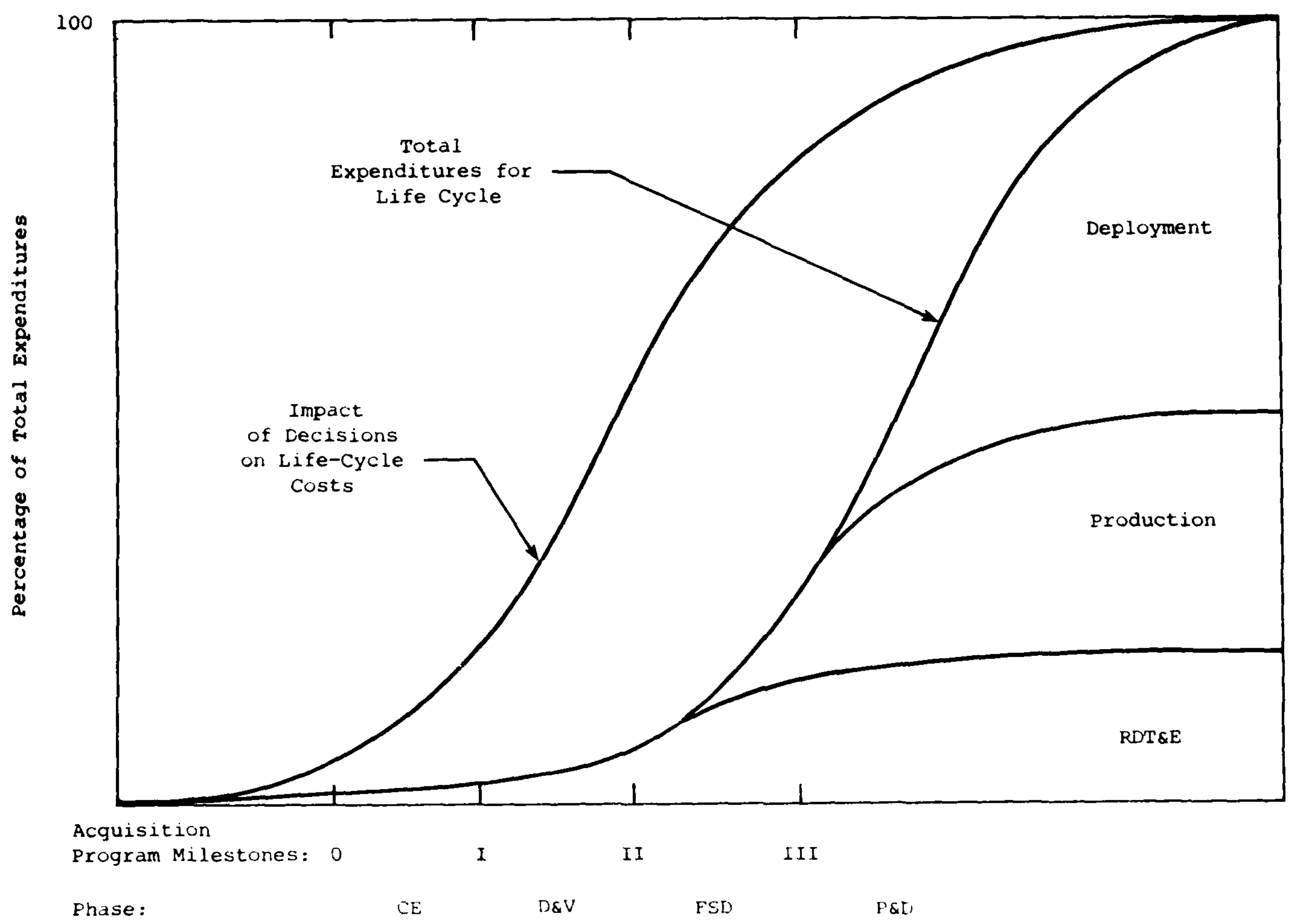

FIGURE 3-1

LIFE-CYCLE-COST DECISION IMPACT AND EXPENDITURES

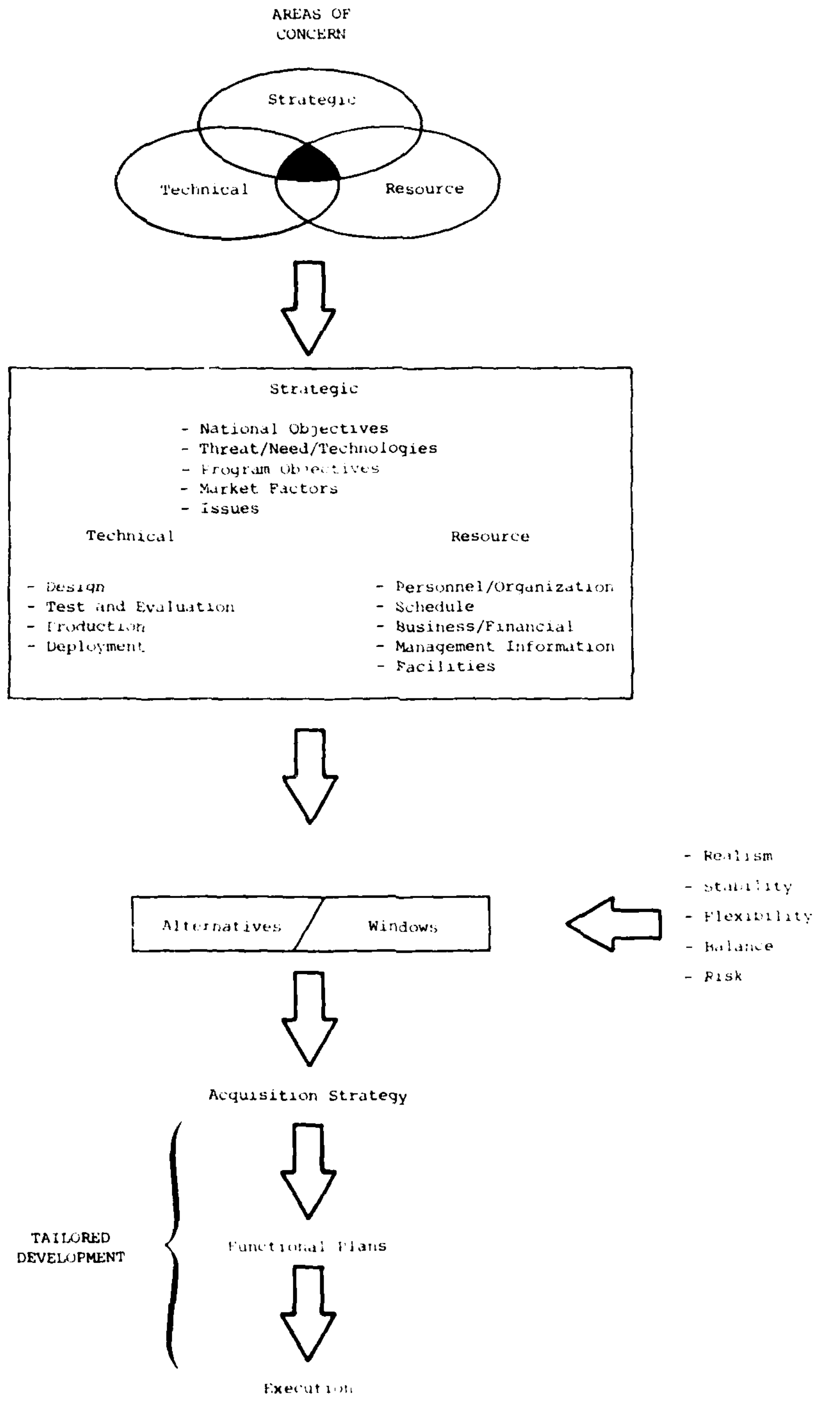

FIGURE 3-2

OVERVIEW OF THE CONCEPTUAL BASIS FOR DEVELOPING AN ACQUISITION STRATEGY

presents an overall structure for an acquisition strategy by focusing on the strategic, technical, and resource areas of concern. While the specific form and content of an acquisition strategy are dictated by applicable service regulations (see Table 1-1), all have common elements related to these three areas of concern.

3.5.1 *Acquisition Strategy Work Breakdown Structure*

The concept of a work breakdown structure (WBS), a hierarchical format, can be applied to help in organizing and structuring an acquisition strategy. Through such a structure, the Program Manager is provided a master check list to ensure that critical strategy elements are not overlooked and that applicable options to meet strategic needs are identified.

There are elements (and subelements) within the strategic, technical, and resource areas of concern. In general, a strategic approach must be developed for each major element in the technical and resource areas on the basis of the objectives, priorities, constraints, issues, and situational realities associated with strategic factors. We use the term *functional strategies* for such approaches. These functional strategies always receive their direction, priorities, and constraints from the acquisition strategy. They are tailored to the specific system and are modified as the acquisition progresses through the various phases. Sections 3.5.2 through 3.5.4 address the three areas of concern and their elements in detail.

3.5.2 Strategic Concerns

Ideally, the Program Manager should be the program strategist. However, in many programs, strategy, or aspects of strategy, are dictated by higher authority. Nevertheless, the Program Manager must be fully aware of the elements of strategic concern and must make every effort to change a dictated strategy that pushes the program beyond the bounds of a feasible, appropriate approach.

To meet the responsibility for formulating and executing the overall acquisition strategy the Program Manager must thoroughly understand the strategic elements:

- The National objectives
- The nature of the threat, the need, and the technology base
- The overall program objectives/constraints/priorities
- The market factors
- The critical program issues

The need to consider the first three elements should be apparent. As discussed in Chapter Two, the National objectives and analyses of the threat, need, and technology form the basis for the macro-defense strategy. A particular program is one element of this macro-strategy with assigned objectives, constraints, and priorities. A Program Manager should fully understand how the program fits into the macro-strategy and why and how the program objectives were determined; i.e., the Program Manager should have a long-range vision of the program.

The market factors element includes both industrial and "political" concerns. Does industry have the capability to meet technical objectives? Are there enough capable companies to create effective competition? Can the industrial base be maintained to meet quantity requirements? The market factor also involves intra-Government and political considerations as well as potential international sales. Programs may also have to be "sold" to the user, higher service levels, DoD, and Congress, especially if there are competing systems.

Critical program issues are related to the existing situational realities. If, for example, a market analysis indicates that there is a high risk that the industrial capability will not meet the quantity requirement within the established schedule, strategic approaches to resolving this problem must be developed.

Table 3-1 lists for each strategic element the subelements that should be considered to develop the overall strategic approach. Subelements for critical program issues will be dependent on the program. Generically, they will fall within the three major areas of technical, cost, and schedule.

A final note on the strategic aspects concerns the character of the acquisition strategy. Others must be convinced that the strategy is a feasible, well conceived, and complete approach to achieving program objectives; that it is consistent with current policy and procedures; and that it can be effectively executed. The criteria of realism, stability, flexibility, resource balance, and controlled risk discussed in Section 3.6 provide a basis for strategy evaluation.

3.5.3 Technical Concerns

Four major elements have been identified as representing the areas of technical concerns:

- Design
- Test and Evaluation
- Production
- Deployment

TABLE 3-1

STRATEGIC CONCERNS

National Policy

- National Security Objectives

Threats/Needs/Technologies

- Threat analysis
- Mission analysis
- Feasible technological innovations
- Countermeasures available
- Requirement to overcome threat
- Technological state of the art required to overcome threat

Program Objectives/Constraints/Priorities

- Technical performance
- Operational capability
- IOC date
- Production cost
- Life-cycle cost

Market Factors

- Industrial base
- Qualified suppliers
- Force requirements
- Overseas requirements/sales potential
- Commercial potential
- Competition from other services in same mission area
- Mission area competition within service
- Competition for scarce resources
- Joint program
- Coproduction overseas
- Political support and advocacy

Critical Program Issues

- Competition
- Defense industrial base
- Concurrency
- Standardization
- Design-to-cost
- Etc.

The extent to which the mission requirements and program objectives can be met by existing technology will directly determine program risk and resource needs. Each technical element will require the development of nonconflicting strategies that must be integrated into the overall acquisition strategy.

In the design strategy the mission requirements stemming from the program objectives, mission profile, and operational environment must be translated into system and then item specifications through system engineering studies. In addition to performance requirements, the strategy must address how the design will satisfy operational suitability requirements—e.g., readiness, safety, reliability, and maintainability. In addition, production, cost, and schedule factors are affected by the design. Basic design approaches should be selected as early as possible, certainly no later than FSD. Design strategy alternatives include P^3I, RSI, design-to-unit production cost, design to life-cycle cost, and warranty/guarantee for R&M achievement and control. Table 3-2 lists elements that should be considered in developing the design strategy.

The test and evaluation strategy is concerned with the type, amount, and timing of testing. Testing could include components, subsystems, and systems, as well as software. Types of testing include developmental, operational, life, qualification, demonstration, and acceptance. In many cases, the limited availability of test resources necessitates some form of combined testing—e.g., combined reliability and maintainability demonstrations. Typical questions that have to be considered include: How much life testing is necessary? How much test, analyze, and fix (TAAF) will be required, and at what levels? What test feedback and failure analysis procedures will be instituted? Can simulation or analytical procedures be used to reduce test time and resource use, and how can they be shown to be valid? How much concurrency is required to obtain test results within the allocated planned schedules? A list of important elements to consider in developing the test and evaluation strategy is summarized in Table 3-3.

The production strategy is concerned with the capability to produce the hardware (and associated software) within stated goals. Initial strategy development must first address establishing feasibility, assessing risks, and identifying capable manufacturers and manufacturing technology needs. Issues of the industrial base and availability of critical materials must also be addressed. The transition from development to production is perhaps one of the most difficult problems facing the Program Manager. It is

TABLE 3-2

TECHNICAL CONCERNS: DESIGN STRATEGY ELEMENTS

Policy Directives and Regulations Mission Requirements - Profile - Environment System Engineering Studies Industry Design Policies Design Objectives - Performance - Producibility - Cost Design Process - System specifications - Requirements allocation - Item specifications - Design criteria - Design margins - Computer-aided design Design Analysis - Physical characteristics - Stress/strength	- Durability - Environmental stress screening - Tolerances - Sneak circuit - Corrosion - Reliability/maintainability - Thermal design factors - Human factors - Safety and health - Nuclear hardening - Electromagnetic impulse - Functional interface Design reviews - Hardware - Software Systems Engineering Management Plan (SEMP) Example Alternatives - DTUPC - P^3I - RSI - Standardization - Technical data package - Warranties/guarantees

necessary to ensure that the design is mature and stable. Further, the production processes, quality assurance procedures, personnel, and facilities must be available and ready to produce the desired product at quantity rates. Strategy alternatives include phased procurement, low-rate initial production, productivity enhancement, and production concurrency with testing. Elements to consider in developing the production strategy are listed in Table 3-4.

The deployment strategy encompasses the field installation, operation, and support of the product. Controlling requirements include operation and support costs, manning levels, readiness and capability rates, and training. One of the first technical elements to be addressed in examining supportability is the maintenance concept, which influences the number and types of personnel, training, facility, and supply system requirements. Strategic approaches must be developed for acquiring the total System Support Package (SSP), which includes spares, inventory, test equipment, training, publications, and data. Other questions to be addressed concern the facility requirements, the use of contractor support, and field maturation. Table 3-5 lists applicable elements to be considered in developing the deployment strategy.

3.5.4 Resource Concerns

Five major elements have been identified as representing the areas of resource concerns:

- Personnel/organization
- Schedule
- Business/financial
- Management information
- Facilities

TABLE 3-3 TECHNICAL CONCERNS: TEST AND EVALUATION STRATEGY ELEMENTS
Policy Directives and Regulations Integrated Test Planning - Test and Evaluation Master Plan (TEMP) -- Type testing by phase - Design maturation -- Development testing - test, analyze, and fix (TAAF); reliability development; reliability growth; mission profile; mission environment -- Life testing -- Qualification testing -- Demonstration testing -- Acceptance testing (PAT&E) -- Software V&V Feedback Reporting - Failure Reporting and Corrective Action Systems (FRACAS) - Uniform test reporting - Test/field on-site report Simulation/Computer-Aided Testing Example Alternatives - Concurrency/sequentiality of testing with design and production activities - Type and amount of testing by phase - Independent testing - TAAF - Simulation

The acquisition strategy must make effective use of the resources available: funds, time, people, organizations, information, and facilities.

Table 3-6 lists the elements that should be considered in developing a personnel/organization strategy. To be considered are such issues as:

- The skills needed in the program office
- The organizational structure of the program office and its relationship to other service commands and DoD
- The method of linking to the user, supporter, tester, and trainer
- The methods of communicating the strategy to others
- Availability and capability of Government personnel

A schedule strategy establishes the approach for meeting critical milestones. Table 3-7 lists the major elements.

In many programs there is a pacing item or activity—one that dictates or defines expected completion dates. An example is the development of a new-technology aircraft engine. If analysis of this pacing item reveals a schedule risk, applicable strategic approaches must be developed, such as phase concurrency, combined testing, and parallel technology development.

A business strategy defines the competitive and contracting approaches to be followed in each phase. Competitive alternatives are numerous (e.g., none, dual source, fusion-fission, leader-follower, breakout) and interact with many other issues, such as using multiyear procurement (to ensure stability and reduce costs) or meeting a requirement to increase the industrial base. The request for proposal (RFP) provides the definitive requirements for the contracted effort. The nature of the RFP, the solicitation approach, the type of contract, the use of incentives, the inclusion of a data-rights clause, and the source-selection strategy all fall within the contracting aspects of the business strategy. Table 3-8 lists the elements that should be considered in developing a business strategy.

A management information strategy defines the approach to establishing suitable information systems for planning and monitoring technical, cost, and schedule progress. Risk management should also be addressed not only for cost and schedule control but also for technical concerns. Accurate, timely, and complete information is an important ingredient in the successful execution of any management approach used by the Program Manager. Numerous tools, such as C/SCSC, PERT, VERT, CPM, and

TABLE 3-4

TECHNICAL CONCERNS: PRODUCTION STRATEGY ELEMENTS

Policy Directives and Regulations	- Defect control - Manufacturing screening
Manufacturing Plan	Long-Lead Items
Transition to Production Plan	Computer-Aided Manufacturing
Producibility Engineering and Planning (PEP) Program	Critical Materials
Manufacturing Process Qualification	Training
- No-conflicts validation - Proof of design - Proof of manufacture - Production readiness reviews	Facilities and Tooling Planning - Special test equipment
-- Prime(s) -- Major sub(s)	Production Acceptance Criteria Example Alternatives
Quality Assurance Program	- Phased procurement (low rate initial procurement)
- Piece-part control - Subcontractor control - GFE/CFE interface - Inspection	- Production start-ups/breaks - Productivity enhancement - Sustained/surge production rate - Concurrency with testing

TRACE, are available to help develop a management information strategy. Important elements are listed in Table 3-9.

A facilities strategy considers the facility requirements for establishing, modernizing, and certifying production and operational capabilities. Productivity, cost reduction, surge capacity, and factory capability are typical concerns. Alternatives to be considered include the use of Government equipment and facilities, industry investment incentives, and GOCO. Table 3-10 lists the elements of this functional strategy.

3.6 ACQUISITION STRATEGY CRITERIA

For an acquisition strategy to provide the basis for meeting program objectives and to aid in gaining program acceptance and support, it must meet certain criteria:

- Realism
- Stability
- Flexibility
- Resource balance
- Controlled risk

This section provides a working definition of each criterion, why it is important, what pressures work against it, and the steps necessary for achieving it.

3.6.1 Realism

3.6.1.1 Working Definition

An acquisition strategy is realistic if the program objectives are attainable and the strategic approach to satisfying them can be successfully implemented with reasonable assurance.

The realism of the program objectives has been included in this definition, for it is impossible to

TABLE 3-5

TECHNICAL CONCERNS:
DEPLOYMENT STRATEGY ELEMENTS

Policy Directives and Regulations

Field Installation

- Deployment plan
- Operations manning
- Operations training
- Facilities

Supportability

- Maintenance concept
- Manning and skill levels
- Training
- ILSP
- Provisioning
- Support organizations
- Publications and data
- RAM verification
- Software integration
- Special test equipment

Mobility and Transportation

System Maturation

Example Alternatives

- Contractor support
- Phased introduction to the field
- Concurrency of testing-production-fielding
- New construction
- RAM growth
- Pre-planned product improvement integration

develop a realistic strategy with unrealistic goals or objectives. Realism cannot be easily quantified, but there are some measurable properties. Realism can often be measured on a relative basis. Of course, a two-fold increase in present performance is more realistic (attainable) than a three-fold increase. Ranking methods and probability and statistical analyses are other measurement techniques.

TABLE 3-6

RESOURCE CONCERNS:
PERSONNEL/ORGANIZATION
STRATEGY ELEMENTS

Policy Directives and Regulations

Personnel Requirements, Selection, and Control

- Program office
- Military Department

Program Organization and Control

- Government/contractor organization and integration
- Joint program concerns
- International program concerns

Statutory Requirements

- Personnel (EEO)
- Environment
- Health and safety

Communication/Networking Matters

- Program
- Military Department
- DoD
- Administration (OMB)
- Congress (Staffs and GAO)
- Media (press/television)

Advisory Boards and Panels

- Blue Ribbon Panel
- Murder Board
- Business Strategy Panel
- Acquisition Strategy Panel
- Defense Science Board
- Military Department Scientific Advisory Board
- Individual experts/consultants

Example Alternatives

- Government or prime contractor system integration
- Support contractor roles
- Military Department Laboratory support
- Blue Ribbon Panel selection

TABLE 3-7

RESOURCE CONCERNS:
SCHEDULE STRATEGY ELEMENTS

Policy Directives and Regulations
Schedule Reserves
Sequence and Timing of Phases
Activities Within Phases
- Pacing activity
- Concurrency of activities
- Duration of activities
- Dependency and independence of events
Example Alternatives
- Overlapping or omission of phase
- Overlap or omit activities in phases
- Combined testing
- Parallel technology development

3.6.1.2 Importance

Only a realistic approach will elicit support for the program at all levels. A strategy that is unrealistic can result in continuous turmoil and crises and may lead to ultimate failure. With mounting evidence that certain milestones are not attainable, the first reaction is to try "Band-Aid" approaches, such as shifting funds from another area or deferring the work. Even if such temporary measures work, the activities that were "taxed" may then be placed in an underfunded position. Deferred activities can cause interface and scheduling problems, leading to more temporary patches.

Clearly, a strategy that may require such approaches is not the way to plan a program. The only way to avoid such a situation is to set requirements and approaches related to technical, cost, and schedule factors well within capabilities. This can also be a form of nonrealism. Programs are not started with planned large expenditures of resources in order to produce relatively minor improvements. Simply stated, the acquisition strategy should represent a conceptual plan that is neither overly optimistic nor overly conservative—another way of defining realism.

TABLE 3-8

RESOURCE CONCERNS: BUSINESS/
FINANCIAL STRATEGY ELEMENTS

Policy Directives and Regulations
Market Analysis
- Military Departments
- Foreign
- Commercial
Competition
- Many alternatives
Industry Environment
- Industrial base
- Capacity
- Financial health
Source Selection
- Draft RFP for comment
- Advertise/solicit bids
- Establish selection criteria
Contracting
- Type/phase
- Incentives/award fees
- Guarantee/warranty
- Leases/licenses
Productivity Enhancement
- Production management systems
- Robotics/testing
- Facilities
Example Alternatives
- Many options in phases
-- Competition
-- Contracting
-- Multiyear procurement
-- Leasing
-- Licensing
-- Recoupment

TABLE 3-9

RESOURCE CONCERNS:
MANAGEMENT INFORMATION
STRATEGY ELEMENTS

Policy Directives and Regulations

Cost Estimation and Control

- Independent cost estimates
- Cost/schedule control system criteria
- Management reserve/TRACE

Schedule Control

- PERT/VERT/CPM

Technical Management

- Interface control
- Design reviews
- Configuration control
- Production management

Risk Management

- Risk assessment/tracking
- Risk management system
- Reallocation of resources

Contract Control

- Deliverables
- Data items

Industry/Contractor Economic Model

Example Alternatives

- Computerized information system
- Networked data base
- Contractor interface procedures

3.6.1.3 Pressures Against Realism

An immediate goal of a program advocate is to gain program acceptance and to see that it is approved, started, and funded. This requirement often induces unrealistic conditions such as matching or exceeding the claimed capability or milestones of a competing approach, or accepting beyond-state-of-the art performance requirements based on an unsupportable analysis of a future threat. It is important that the Program Manager recognize the types of pressures acting against a realistic strategy and counter them appropriately. Table 3-11 lists the more common pressures.

TABLE 3-10

RESOURCE CONCERNS:
FACILITIES STRATEGY ELEMENTS

Policy Directives and Regulations

Modernization of Existing Facilities

- Technology modernization
- IMIP

Factory Improvements

- Machines/tooling
- Productivity centers

Certification of Contractors

Construction of New Facilities

Use of Government Facilities, Equipment, and Laboratories

Example Alternatives

- GOCO
- Capacity/surge capabilities
- New versus improved facility

3.6.1.4 Achieving Realism

Mandating realism is easy, but achieving it is often difficult. There is no simple formula. Table 3-12 lists actions that might be taken to provide a basis for a realistic strategy. Table 3-12 shows that achieving realism should involve detailed study of the threat, assessment of the state of the art in all technology areas, review of past performance on similar acquisitions or systems, and a survey of industry capability. Studies take time and resources; but since realism is such an important criterion for a successful strategy, every effort should be made to support this undertaking in critical areas.

TABLE 3-11 PRESSURES WORKING AGAINST REALISM	
Pressure	**Description and Effect**
Forced Outcome	Firm set of requirements that do not permit trade-off. Program Manager must force-fit strategy.
Directed Strategy	Strategy mandated by higher levels, usually a single alternative and not based on careful planning. Can be highly optimistic with respect to schedule and resource requirements.
Micro-Management Avoidance	To avoid future micro-management, the Program Manager may adopt a "close to the vest" syndrome, so that only minimum details of the conceptual approach are presented. Guidance is withheld from functional managers, and a gamble is taken on the approval process.
Low Service Priority	For programs that do not have high priority within the service, the Program Manager may include in the strategy a doctrinally correct recitation of functional concerns and approaches to avoid controversy and thereby ignore the real interests and program concerns.
Strong Competition	Competing system or strong high-level service, DoD, or political opposition. Program Manager feels forced to counter these elements without assessing potential for successful accomplishment.

3.6.2 Stability

3.6.2.1 Working Definition

Acquisition stability is the characteristic that inhibits negative external or internal influences from seriously disrupting program progress. These negative influences frequently cause changes in cost, schedule, or performance requirements that can threaten the achievement of milestones.

It would be naive to assume that any significant program will not encounter situations that can change the course of the program to some extent. Some of these situations may well be beyond any strategic program control—e.g., a validated intelligence report of a greatly increased threat capability of the Soviet Union that seriously negates the operational value of the system under development. However, there are many potential causes of instability that can be countered to some extent by a carefully designed acquisition strategy.

TABLE 3-12 ACTIONS FOR ACHIEVING REALISM
Analyze the threat to understand fully the mission need and the required technical performance and schedule constraints.
Identify the functional support talents required to assess realistic requirements and approaches and ensure that they are on board during the strategy-development phase.
Establish a "blue ribbon" panel of experienced and highly competent technical and resource people to review requirements and approaches.
Study similar acquisitions to establish a baseline for cost and schedule milestone accomplishments. Perform independent cost and schedule assessments by expert agencies or uninvolved contractors.
Analyze similar systems to establish a baseline for technical requirements. Use Government laboratories or uninvolved contractors for independent assessments.
Perform detailed cost and schedule analyses using "what if?" and "worst case" analysis procedures to identify potential problem areas.
Analyze the capabilities of industry to produce systems that can accomplish the mission.
Establish applicable contingency plans to address the more risky areas of the development process as identified in the studies recommended above.

3.6.2.2 Importance of Stability

At least twelve of the original acquisition initiatives first published by the Department of Defense in 1981 are directly concerned with the effects of performance, quantity, and schedule changes on the acquisition program. Any change in critical system or acquisition parameters can ripple throughout the program, cause serious disruptions, reduce confidence in program estimates and assumptions, increase Government and contractor risk, and reduce morale and motivation. Frequently, when a major change is made, as in funding, a "downstream" parameter such as operational readiness or logistics support bears the brunt of the change, and system operational capability can be significantly affected.

3.6.2.3 Pressures Working Against Stability

Table 3-13 lists some of the more important pressures leading to instability that the Program Manager should recognize in developing the acquisition strategy.

3.6.2.4 Achieving Stability

Three elements related to acquisition strategy can enhance program stability:

- Direction
- Advocacy
- Commitment

TABLE 3-13

PRESSURES WORKING AGAINST STABILITY

Pressure	Result/Effect
Funding Process	Yearly funding levels and streams may change as a result of Congressional or economic factors. This may cause reallocation of requirements and priorities, leading to reduced capability.
Requirements Changes	Requirements changes occur when the user is uncertain of the need or required capability of the system or perceives a greater or lesser threat. Results in decreased user support and disruption of technical progress.
Changing Acquisition or Philosophy/Policy	Changing administrations, executives, political climates can result in revised policy, which can affect stability. Pressures may be exerted on existing programs to conform to the new thinking.
Industry Risks	Contractors may be faced with an untenable risk or profit position through buy-in, loss of a major contract, or failure to modernize. This may lead to instability requiring additional money and time, and possibly new contractor sources.
Organization/Personnel	Changes in organization and personnel can cause disruptions; lack of continuity; lack of accountability; loss of audit trail; and changes in directions, processes, and procedures.

Table 3-14 defines each of these elements, describes why they are important, and suggests some approaches for incorporating them into the acquisition strategy.

3.6.3 Resource Balance

3.6.3.1 Working Definition

Resource balance is a condition of equilibrium between and within major program objectives that are competing for resources.

The achievement of cost, schedule, and technical requirements uses resources of time, people, facilities, and money — all of which are limited. The degree of balance is not usually measured directly, but it can be measured in terms of risk in meeting objectives. In this sense, a balanced program is one for which all the risks are approximately equal, where the risk measure includes establishment of priorities and assessment of damages in case of failure.

TABLE 3-14 STABILITY ELEMENTS RELATED TO ACQUISITION STRATEGY		
Stability Element	Description	Importance
Direction	A strategy that clearly delineates program objectives, approaches, and control procedures	Programs that show lack of purpose and control are likely candidates for funding cuts. Strategy must impart a sense of knowing where you are going, and when and how you are going to get there.
Advocacy	Support from high-level positions in the military service, DoD, Congress, and the Administration	Initial targets for program changes are programs without high-level support. Know who the initial supporters are, keep them informed, and "cultivate" new supporters.
Commitment	Agreements that cannot be easily canceled	If the Government establishes an agreement with external parties, then a measure of stability is achieved. Two of the more significant types are (1) a Memorandum of Understanding (MOU) with a foreign government for joint development or future delivery, and (2) a Multi-Year Procurement (MYP) contract with a contractor.

3.6.3.2 Importance of Balance

A Program Manager must respond to high-level direction, which often presents conflicting demands. For example:

The acquisition cycle must be reduced.
vs.
Operational testing under realistic conditions must precede production release.

Development and production costs must be minimized.
vs.
High performance and readiness are key objectives.

Overemphasis on one objective could jeopardize the chances of meeting other objectives. By fully understanding the priorities, relationships, risks, and required resources for each objective, the Program Manager can develop a strategy that provides the necessary balance and the justification to say "No" with conviction when changes by the user, headquarters, contractors, or others, are requested.

3.6.3.3 Pressures Working Against Balance

Parochialism is probably the major pressure working against balance. Just as the Program Manager must do everything legitimately possible to ensure that the program is successful, functional managers operate from the same premise. The Program Manager must recognize that the user wants the best-performing system and wants it quickly, financial offices in Headquarters want to lower cost, and the contractor wants to lower risk. In addition, external situations can occur that may have a severe impact

on balance. Examples include the emerging importance of environmental impacts, energy concerns induced by fuel shortages, and reduced funding because of the economic climate.

3.6.3.4 Achieving Balance

Understanding the mission requirements and priorities of objectives is a key factor in achieving balance. Another key factor is risk. Resources must be allocated to achieve a required level of capability with acceptable risk. A third factor is the amount of resources—rarely enough to "comfortably" do everything. Table 3-15 suggests approaches to considering these factors in developing a balanced acquisition strategy.

3.6.4 Flexibility

3.6.4.1 Working Definition

Flexibility is a characteristic of the acquisition strategy related to the ease with which changes and failures can be accommodated *without significant* changes in resource requirements. A strategy that allows for no change in approach is one that is destined to be challenged by events.

As with the other characteristics discussed, there rarely is a single measure that can be used to quantify flexibility. One useful analysis approach can be called "what if?"—a form of contingency planning:

- What if one development contractor drops out?
- What if the technical development of the XYZ component fails?
- What if a new technology becomes available?
- What if Congress cuts the program budget by 15 percent?
- What if the only capable contractor does not modernize its plant or equipment?
- What if a certain activity is completed 6 months later?

Through such analyses, areas where flexibility is needed can be identified and measures can be taken to provide "back-up" or alternative approaches to meeting objectives.

3.6.4.2 Importance of Flexibility

One of the most predictable occurrences in an acquisition program is change. Flexibility enables the Program Manager to deal with change—to bend but not break. Without flexibility, changes can throw a program out of balance, leading to instability, unrealistic approaches, insufficient resource allocations, and intolerable management problems.

3.6.4.3 Pressures Against Flexibility

As indicated in the discussion of stability, those who review a program should be given a strong feeling that the acquisition strategy is directed toward successful accomplishment, with all major areas addressed. That does not mean that all approaches are so firmly fixed that changes or failures cannot be accommodated—indeed, identifying the areas where change or failure is possible and employing approaches to deal with them are signs of good strategic planning. However, some may insist that a strategy must be firmly cast to exclude such possibilities. Frequently there are pressures against maintaining "reserve resources." If the nominal schedule estimates indicate a five-year development, that is what the user may insist upon, even if such a schedule allows no "space" for dealing with any significant problems.

3.6.4.4 Achieving Flexibility

The first step in developing a strategy with sufficient flexibility, of course, is to identify areas in which there is a significant probability that changes and failures could occur.

What is "significant"? Not everything can be covered; otherwise the strategy becomes so flexible that it offers no firm basis for proceeding. One might adopt the approach that any significant potential change or failure with a subjective probability of occurrence of 20 percent or more should be addressed through a flexible strategy. In the range of 5 to 20 percent, strategic flexibility measures should be applied on a priority basis, depending on the criticality of the potential event and its probability of occurrence. Under 5 percent is the "gamble region," where no specific strategy development action is necessary unless the change or failure can be catastrophic to the program. Note that by the inclusion of the probability of failure and the consequences of failure (criticality), this approach casts the problem in terms of risk analysis (see Section 3.6.5).

Table 3-16 lists approaches for achieving flexibility and describes their development and implementation.

TABLE 3-15

FACTORS IN AND APPROACHES TO ACHIEVING
A BALANCED ACQUISITION STRATEGY

Factor/Approach	Discussion
Information	How long should the development cycle be? How much should a production unit cost? How accurate can the system be? Answers to questions such as these are obtained through analyses of similar developments and systems. They will provide a basis for estimates useful for initial resource allocation.
Priority Analysis	Determine the importance of the objective and the requirements for establishing a priority ranking. Risk levels in resource allocation are then assigned to account for varying priorities.
Resource Allocation	Do not defer allocating resources for a major element. While flexibility is important, such major deferral can often "suck up" unassigned resources simply because they are unassigned. This is not the same as providing a reserve.
Concurrency	Concurrency entails performing more than one necessary task simultaneously, e.g., multipurpose testing. Generally, risks are increased, but cost and resource usage might be reduced and development time shortened.
Cost/Risk Sharing	The Program Manager may be able to adopt a contracting strategy that helps to achieve balance. For example, a fixed-price development effort may be acceptable if there is potential for long-term, high-value business. The contractor may be willing to undertake reliability-achievement risks, such as through an MTBF guarantee, if there will be a benefit in exceeding target levels. By the reduction of risks through this approach, more resources can be made available in other areas, thereby helping to achieve the desired balance.

TABLE 3-16	
ACHIEVING FLEXIBILITY	
Factor/Approach	Discussion
Dual Sourcing	For any stage of the acquisition process, dual sources offer a flexibility that can help ensure program success. While dual sourcing is initially much more costly than single sourcing, its associated competitive aspects may lead to significant savings in production and will expand the production base.
Contract Flexibility	Contracts can be written to provide needed flexibility in areas of uncertainty -- thus subjecting neither the contractor nor the Government to high risks because of changes. One common example is the use of price-escalation indices to adjust for significant economic changes or pricing for variable quantities.
Pre-Planned Product Improvement (P^3I)	In technology areas of high risk and uncertainty, it may be prudent to plan for block changes of new technology through the P^3I approach.
Management Reserves	If all resources are firmly allocated, then, almost by definition, all such resources are absolutely needed. As in battle situations, rarely should the Program Manager commit everything initially without any reserves.
Functional Flexibility	Every program will experience personnel turnovers, some in key functional positions. The acquisition strategy and lower-level functional strategies must be flexible enough to permit a variety of tactical implementation procedures that will accommodate preferences of new managers.

3.6.5 Controlled Risk

3.6.5.1 Working Definition

Risk, as applied to acquisition strategy, is a measure of the probability and consequence of not achieving a defined program goal.

Most people agree that risk involves the notion of uncertainty. Can the specified aircraft range be achieved? Can the torpedo be produced within budgeted cost? Can the IOC date be met? A probability measure can be used for such questions; e.g., the probability of not meeting the IOC date is 0.15. However, it is now generally accepted that when risk is considered, the consequences or damage associated with failure must also be considered.

Goal A, with a failure probability of only 0.05, may present a much more serious (risky) situation than Goal B, with a failure probability of 0.20 if the consequences of not meeting Goal A are more severe than failure to meet Goal B.

Conceptually, then, risk can be defined as a function of uncertainty and damage; i.e.,

$$\text{Risk} = f\ (\text{uncertainty, damage})$$

In general, as either the uncertainty or damage increases, so does the risk. Both the uncertainty and the damage must be considered in a risk analysis.

Another element of risk is the cause of risk. Something, or the lack of something, induces a risky situation. We denote this source of danger as the hazard. Certain hazards can be overcome to a great extent by knowing them and taking action to overcome them. A large hole in a road is a much greater danger to a driver who is unaware of it than to one who travels the road frequently and knows enough to slow down and go around the hole. This leads to the second conceptual equation:

$$\text{Risk} = f\ (\text{hazard, safeguard})$$

Risk increases with hazard but decreases with safeguard. The implication of this equation is that the acquisition strategy should be structured to identify hazards and to allow safeguards to be developed to overcome them. If enough safeguards are available, then the risk can be reduced to an acceptable level.

3.6.5.2 Importance of Risk Assessment

Risk assessment is the underlying analysis approach for acquisition strategy development. It provides one basis for determining conformance to the other four criteria—realism, stability, resource balance, and flexibility—and for selecting approaches for improving the strategy characteristics. In fact, it can be argued that the four criteria are elements necessary to minimize program risk through the acquisition strategy.

3.6.5.3 Pressures Working Against Risk Minimization

There is no specific pressure that inhibits risk minimization other than constrained resources. OMB Circular A-109 and DoD Directives 5000.1 and 5000.2 specifically direct that the risk issue be addressed. However, risk is not always easy to assess, since the probability of failure and the consequence of failure are usually not measurable parameters and must be estimated by statistical or other procedures. While formal risk analysis procedures deal with the "known unknowns," there is also the issue of the "unknown unknowns."

Here, only qualitative assessments are usually possible. Yet, despite these difficulties, risk assessment provides a formalism and structure for selecting strategy alternatives and should be a major element in the decision-making process.

3.6.5.4 Achieving Risk Minimization

Two references on risk assessment procedures that provide more specific detail are:

- *Risk Assessment Techniques—A Handbook for Program Management Personnel*, Defense Systems Management College, July 1983.
- *System Engineering Management Guide*, Defense Systems Management College, October 1983.

Chapter Four presents a simplified approach to evaluating strategy alternatives that embodies some elements of risk analysis. A risk management system should be established within the overall program management information system.*

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*DoD Directive 4245.7, *Transition from Development to Production*, directly addresses the technical risk issue and authorizes the use of the document *Solving the Risk Equation in Transitioning from Development to Production*, Defense Science Board, May 1983. This document is preliminary to the forthcoming manual DoD 4245.7-M.

3.7 SUMMARY

In this chapter acquisition strategy has been defined as a conceptual basis of the overall plan to follow in program execution. The acquisition strategy is the basis for all functional strategies, plans, and tasking; it provides a coordinated approach to achieving program objectives *within the constraints placed* on the program.

The primary ingredients for a successful acquisition involve strategic, technical, and resource concerns. Program objectives must be established, controlled, and assessed to permit the deployment of a militarily useful system or equipment that meets cost, schedule, performance, and supportability goals. The Program Manager's approaches to meeting these program objectives must satisfy legal, executive, and service policy considerations. Finally, the acquisition strategy has objectives, criteria, priorities, and constraints of its own: it must show how the system and program objectives will be met, how policy and procedures will be accommodated, and how the conduct of the program will meet such criteria as realism, stability, resource balance, flexibility, and controlled risk.

CHAPTER FOUR

ACQUISITION STRATEGY DEVELOPMENT AND EXECUTION

4.1 INTRODUCTION

This chapter focuses on the elements to be considered in acquisition strategy development and execution. It presents an iterative process for developing, implementing, and modifying a continuously evolving acquisition strategy. Figure 4-1 is a flow diagram of the acquisition strategy development and execution process. This chapter is structured to discuss each of the elements included in the figure.

4.2 DEVELOPMENT

The following are the key steps in developing (and, as Figure 4-1 shows, "revising") an acquisition strategy that meets the criteria of realism, stability, resource balance, flexibility, and controlled risk:

- Identify the mission need
- Assess the situational realities
- Assemble strategy development resources
- Establish strategic goals, risk levels, and priorities
- Identify specific alternatives
- Establish decision criteria
- Evaluate alternatives
- Develop overall strategy

These steps are reviewed in the following subsections.

4.2.1 Identify the Mission Need

The overriding priority of an acquisition strategy is to satisfy a mission need—a need that results either from a deficiency in current or projected capabilities or from a technological opportunity to establish new or improved capabilities. It is imperative that the strategy developer clearly identify the mission need and ensure that it is clearly articulated to all participants in the acquisition. The mission need imposes overall program requirements and constraints particularly on technical factors, but also on cost and schedule factors.

The Program Manager should review and analyze applicable documents related to mission need, such as the JSMNS and threat analysis studies. Program objectives should be prioritized so that strategic alternatives can be assessed within a decision framework that permits trade-off analysis.

4.2.2 Assess the Situational Realities

The situational realities faced by the program include the system-related performance, cost, and schedule requirements; the general review requirements and procedures associated with the military acquisition process; the impact of other programs' acquisition strategies; and the resources (time, money, and experienced people) available to complete the strategy development.

Each program's strategy development does not occur in a vacuum, but must proceed in its own particular acquisition environment. Successful acquisition strategy development requires the Program Manager to know where the program stands in that environment at any particular time. Some programs may be "go" from the beginning, with relatively few disturbing influences to hinder them. However, most programs have critics. There may be segments of Congress who oppose the program from a need, financial, or political viewpoint. A program may also have opponents within OSD, the other services, or even its own service, who have, or believe they have, valid reasons for their positions. The Program Manager, with a full understanding of how the program fits into the National Objectives, should work with the operational users to do everything legitimately possible to ensure the program's success

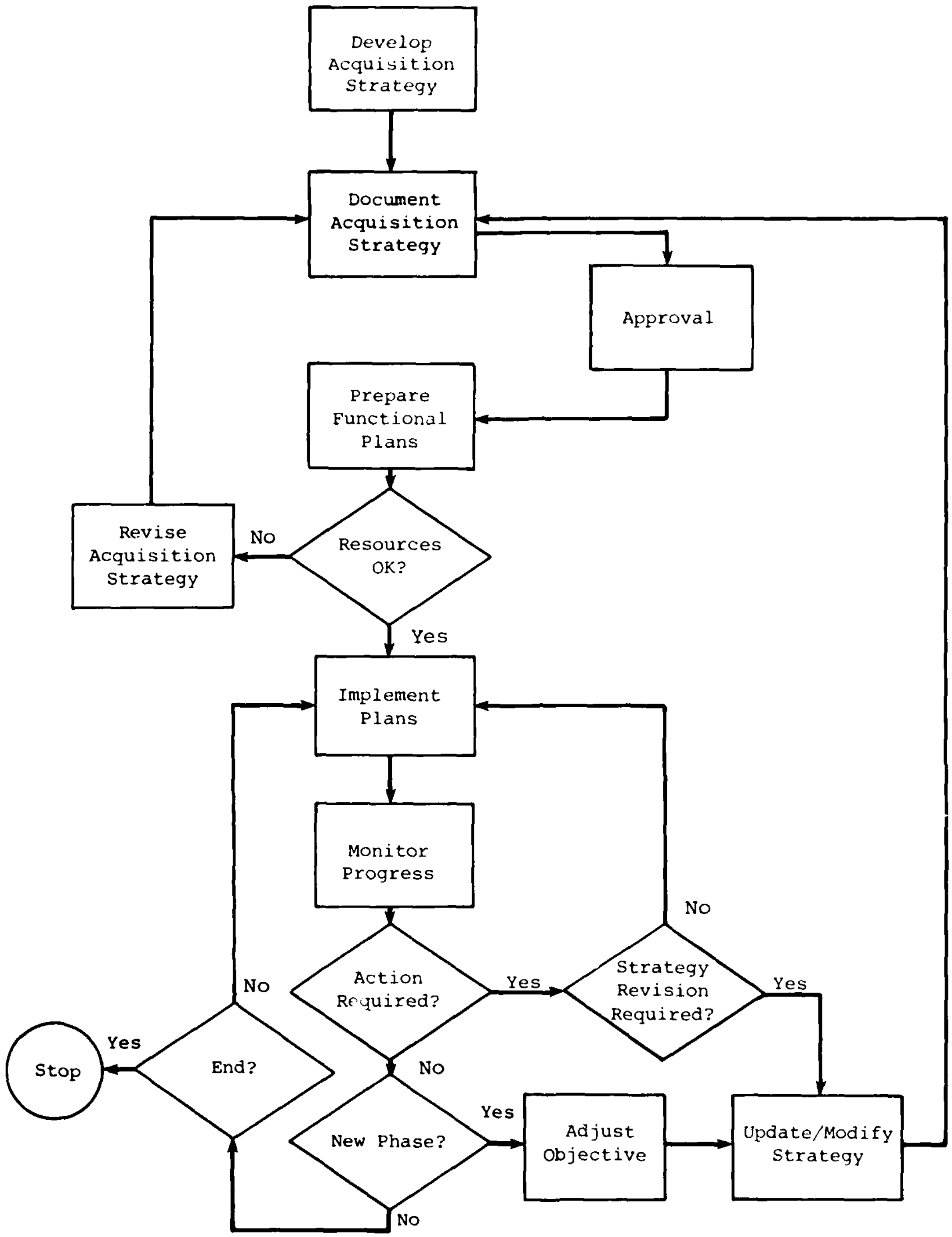


FIGURE 4-1

THE ACQUISITION STRATEGY DEVELOPMENT AND EXECUTION PROCESS

– in much the same way as a lawyer, who has a responsibility to do everything legitimately possible to defend the client. The development of an effective acquisition strategy is an important means of countering opposition and enhancing advocacy for the program.

Table 4-1 is a check list for performing a situational assessment.

4.2.3 Assemble Strategy Development Resources

Strategy development will require resources – people, time, money, and information. Table 4-2 is a check list of resources that normally are required for effective strategy development. A typical strategy development team is shown. Strategy must be developed in an interactive, integrated manner, rather than as a collection of separate inputs that can lead to functional discord. While all of the team members are important, for the initial strategy a seasoned technical manager and a knowledgeable and experienced business manager may be the most important, since the technical and business strategies often co ı trol critical milestone accomplishment.

It is also important that the user representative have the knowledge, experience, and capability to ensure that operational concept considerations are adequately adhered to. The user representative is the Program Manager's key liaison to the operational community and therefore must have a thorough working understanding of mission needs and operator biases.

TABLE 4-1

CHECK LIST: SITUATIONAL ASSESSMENT FOR ACQUISITION STRATEGY DEVELOPMENT

To start the acquisition strategy development process, the Program Manager and staff must have an appreciation and understanding of the following:

- Program-Related National Objectives
- Mission Need
- Technical Requirements
- Cost Requirements
- Schedule Requirements
- Program Constraints
- Program Advocates
- Program Opponents
- Competing Systems
- Expected "Attack Points"
- Program Review Process
- Technology Factors
- Industry Capability

TABLE 4-2

CHECK LIST: ASSEMBLING STRATEGY DEVELOPMENT RESOURCES

To start the acquisition strategy development process, the Program Manager should have available applicable resources in the following categories:

Acquisition Strategy Development Funding and Time

Mission Analysis Studies

Cost, Schedule, Technology Studies

Strategy Development Team

- Technical Manager
- Business Manager
- Logistician
- Contracting Officer
- User Representative
- Special Consultants
- Communicator
- Secretary

4.2.4 Establish Strategic Goals, Risk Levels, and Priorities

When the mission need is thoroughly understood, an assessment of the situational realities has been performed, and the resources for strategic development are available, the strategy development can begin. Program-specific strategic goals or objectives should be listed and prioritized (e.g., foster competition throughout program, increase industrial base, achieve NATO standardization). The difficulty of achieving each goal should be broadly assessed, as should the consequences of not achieving the goals. This assessment, together with the prioritization, provides a basis for assigning risk levels. At this stage, such levels may be qualitative (e.g., high, medium, and low). The risk levels then provide direction for developing strategic alternatives that can concentrate resources effectively.

4.2.5 Identify Specific Alternatives

The strategy developer must identify candidate approaches for ensuring that each goal, objective, or requirement is met. In the same way as the formal program requirements, the selection of alternatives should be based on the situational factors. Table 4-3 is a check list for ensuring that applicable factors have been considered in identifying the strategy alternatives. Major DoD issues and alternatives related to *acquisition strategy* (e.g., competition, standardization, incentives) are discussed in Chapter Five.

TABLE 4-3

ACQUISITION STRATEGY: PRE-DEVELOPMENT CHECK LIST FOR IDENTIFYING STRATEGY ALTERNATIVES

Have overall objectives been assessed with respect to realism and criticality?

Have major risk areas been identified?

Have program advocates been identified and contacted?

Have program opponents been identified and contacted?

Have competing systems (new, in acquisition, planned) been identified and evaluated?

Have strategy alternatives been identified to:

- Meet overall objectives?
- Attack major risk issues?
- Strengthen advocate support?
- Reduce opposition impact?
- Make the system better than competitor systems?

4.2.6 Establish Decision Criteria

Given that the program requirements have been established, priorities and risk levels assigned, and candidate solutions identified, the strategy development problem can then be considered to be a classical decision problem – in particular, one of resource allocation with multiple objectives. Such problems are not easy, especially when so many potential future impacts are unknown or not fully understood. It is here that the strategy criteria discussed in Chapter Three become important for guiding the decision-making process.

In evaluating candidates, the Program Manager should include in the decision criteria realism, stability, resource balance, flexibility, and risk minimization. A decision model should be formulated so that each candidate can be "scored" on these criteria and an assessment made of how well the stated objectives/requirements can be met. Table 4-4 is a summary check list of the factors associated with establishing the decision criteria.

4.2.7 Evaluate Alternatives

The decision criteria and decision model are applied to the identified alternatives. Such an evaluation cannot be performed in a mechanical fashion – the problems are complex, the uncertainties are substantial, and the criticality is high. While there are a number of mathematical, statistical, and economic tools available for such evaluation, judgment and experience must still play major roles. Equally important are information and data. A simplified approach

TABLE 4-4 CHECK LIST: DECISION CRITERIA
The Program Manager should include the following in establishing the decision criteria: Prioritized Rating of Objectives/Requirements Realism Factors Resource Balance Factors Flexibility Factors Stability Factors Risk Factors Decision Model

for evaluating alternatives is presented in Section 4.7. Chapter Five summarizes key features of major strategy issues and alternatives, including experience and data that can aid in evaluating them.

4.2.8 Develop Overall Strategy

When the evaluation is completed, a preferred overall strategy is developed. This strategy includes the applicable strategic, technical, and resource factors discussed in Chapter Three and uses combinations of the alternatives described in Chapter Five. Sections 4.3 through 4.7 describe the processes for documenting, implementing, managing, and revising the initial strategy.

4.3 DOCUMENTATION

Documentation encompasses two categories. First, the Program Manager documents the strategy—that is, actually prepares the acquisition strategy in a format that is useful, complete, and appropriate for the particular service's approval process. Second, the approved strategy serves as the basis for preparing the program's functional plans, through which specific objectives are accomplished.

Formatting the acquisition strategy is a straightforward process, with the Program Manager tailoring the document to the particular service's list of subjects to be considered. The formats were presented in Table 1-1 of Chapter One. An important element of documentation is the treatment of the acquisition strategy sections in decision documents such as the JMSNS, SCP, DCP, and IPS. These documents are designed purposely not to communicate the same depth of information concerning program objectives, alternatives, and issues as the formal acquisition strategy document. Accordingly, the sections of the decision documents that address acquisition strategy need only synopsize the highlights of the Program Manager's overall strategy, with most emphasis on the next phase of the acquisition process.

With respect to the three general types of program documentation -- requirements, decision, or functional—the acquisition strategy can be considered both as a requirements statement of what the Program Manager believes must be accomplished to meet the stated objectives of the program and as a decision document to provide overall program direction. The acquisition strategy, to serve as the source of objectives for functional implementation plans, should not contain planning details. Rather, it should provide a clear understanding of the issues to be addressed throughout the life of the program, i.e., a roadmap or "plan to plan with."

Figure 4-2 shows "functional strategies" linking the overall acquisition strategy and the functional plans. Even though all functional plans flow from the acquisition strategy, one is so important that it deserves special mention: the Acquisition Plan. Sometimes called the Procurement Plan, Advanced Procurement Plan, or Contracting Plan, the Acquisition Plan is required by the FAR and must be approved before significant contractual actions are initiated. Although the plan is similar in content to the acquisition strategy (so close that the Air Force considers the plan to be the Program Manager's acquisition strategy), there is a fundamental difference: the strategy should be broad in considering the system life cycle, while the plan specifically addresses the immediate procurement action. As Figure 4-2 illustrates, however, the Acquisition Plan not only flows from the strategy but also connects to all of the other functional plans. The experienced Program Manager will recognize that one of the advantages of an up-to-date acquisition strategy is that its information readily serves as the framework for the Acquisition Plan and the functional plans.

4.4 APPROVAL

The approval element of the development and execution process comprises the steps for gaining approval of the Program Manager's complete documented acquisition strategy, but not the acquisition

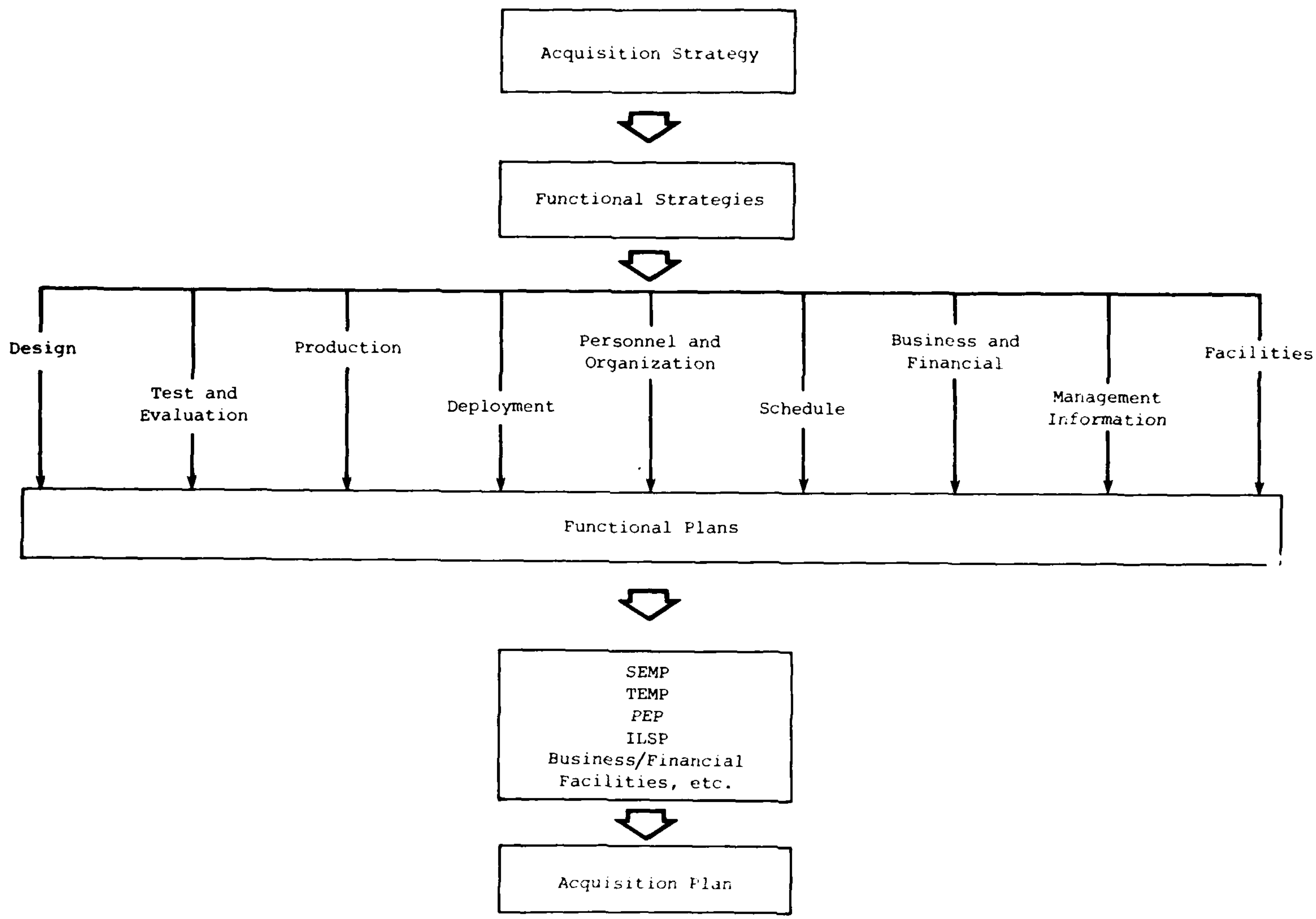


FIGURE 4-2

FLOWDOWN OF ACQUISITION STRATEGY TO
FUNCTIONAL STRATEGIES AND PLANS

strategy sections of the DoD decision documents (JMSNS, SCP, and DCP). Interestingly, there is no standard procedure for OSD evaluation of a Program Manager's overall acquisition strategy; thus OSD approval, if required, comes only in the form of approval of the program's milestone documents. Service approval of the Program Manager's acquisition strategy, however, is obtained within each of the developing commands.

4.4.1 Service Approval Procedures

The following general descriptions are for information only; they reflect service development command procedures as of March 1984. Since this information may be outdated because of revised guidance, the reader should contact the cognizant service office before initiating any approval action.

Army (DARCOM/DRCDE-A, Phone 202-274-9060)

An acquisition strategy, documented in the format of AR 70-1, *System Acquisition Policy and Procedures*, 15 February 1984, is reviewed and approved at the appropriate decision level: HQ, DARCOM for DoD Major, Designated Acquisition programs, and DA In-Process Review (IPR) programs; and the appropriate Major Subordinate Command (MSC) Commander for programs with IPR decision authority delegated to that Commander.

Navy (NAVMAT 021, Phone 202-692-3533)

NAVMAT INST 5000.29A, *Acquisition Strategy Paper*, 6 May 1983, clearly describes the Navy's acquisition strategy format and approval process. This office is experienced in acquisition strategy review and approval. (The Marine Corps is also governed by NAVMAT INST. 5000.29A.)

Air Force (HQ AFSC/SDX, Phone 301-981-2255)

Because AFSC Supplement 1 to AFR 800-2, *Program Management*, dated 3 January 1983, states that "The Program Manager's acquisition strategy will be the acquisition plan . . . modified to meet individual program needs," the approval comes through the procurement organization via a Business Strategy Panel review.

4.4.2 Lessons Learned for the Approval Process

Experience in acquisition strategy approval at the development command level has provided these "lessons learned":

- As early as possible in the approval process, Program Managers should identify the program's opponents, especially those with veto power. Every reasonable effort should be made to enlist their support through such methods as special briefings or inclusion on program advisory panels.
- Program Managers should thoroughly address risk assessment. There is evidence to suggest that this is the most important review/approval consideration in the acquisition strategy.
- Program Managers should determine if there are management issues that should be included, in addition to the required format items. These current topics can be obtained from the appropriate development command office of primary responsibility.
- Program Managers should start early and keep an auditable document trail. They should include in the strategy any significant guidance, both written and oral. This enables subsequent Program Managers and reviewers to follow the program's decision process closely.
- Program Managers should convene and make full use of a committee to review and critique the acquisition strategy before submitting it to the approval process.
- Program Managers should ensure that the strategy is kept current by using a knowledgeable, qualified person to maintain it and by using modern word processing equipment to enable rapid updating.
- Approval commands should assure that the acquisition strategies are reviewed by top-level personnel with broad perspectives. This will prevent lower-level functional elements from including excessive planning details in the strategy.

4.5 STRATEGY MANAGEMENT

The acquisition strategy is managed through control of the functional plans. The three functions of control—direction, detection, and correction—describe the activities that are included in strategy management.

Direction is using resources (e.g., people, dollars, time) to implement plans. Detection is the use of tools (further addressed in Section 4.7. of this chapter) to compare actual with planned results. Correction follows; if action is required, it causes changes to plans. Planning and control are complementary, and the Program Manager's success in managing the acquisition strategy is directly related to his or her control of the functional plans. Table 4-5 is a check list for evaluating and enhancing the degree of control available to the Program Manager.

TABLE 4-5

CHECK LIST FOR EVALUATING DEGREE OF PROGRAM MANAGER CONTROL

How well do the functional managers and their staffs understand what is to be done and how it is to be done?
Is there sufficient, valid information available to report on task progress in a complete, timely manner?
How open are the lines of communication from the points of action through the functional managers to the decision-makers at the Program Manager level?
Are there clear, understandable, and precise standards of performance by which to compare actual performance?
What is the reward system within the project for reporting unsatisfactory progress? Are the functional managers motivated to provide only optimistic news?
How effectively can the followup process complete the loop between problem identification and resolution?

Detection, the link between direction and correction, requires a management information system (MIS) to provide systematic verification of internal (Government) and external (contractor or other Government agency) performance in implementing functional plans. Areas to be considered include cost control, schedule control, technical management, risk management, and contract management. Program Managers should ensure that their MISs are implemented early, satisfy their needs, and meet the criteria shown in Table 4-6.

4.6 STRATEGY UPDATE/MODIFICATION

As shown in Figure 4-1, there are three primary situations that necessitate updating or modifying the acquisition strategy: (1) insufficient resources, (2) pro-

TABLE 4-6

MANAGEMENT INFORMATION SYSTEM CRITERIA

Standards are clearly established.
Reporting requirements are limited to the least required.
Contractor reporting information from the data base is actually used for internal management decisions.
Reporting information is organized in work breakdown structure (or similar) format.
Information (not merely data) needed to support accomplishment of the program's critical goals is provided.
Regular and periodic summary reports of all progress are submitted to Program Manager.

gram changes and problems, and (3) the change from one program phase to another. The first situation, updating on the basis of insufficient resources, is closely related to the initial actions for developing the strategy, and the same process is followed. The second situation concerns changes and problems encountered in the execution of the acquisition strategy during a particular phase. The third updating situation, program phase changes, is required more from the standpoint of good management practice than from that of policy. Although service regulations are generally definitive on the process for development and approval of the acquisition strategy, their guidance on updating is less clear. OMB Circular A-109 calls for strategy updates to be made as the program progresses through the acquisition cycle, and the DoD 5000 series instructions require that the Program Manager update decision documents at planned milestones. It appears logical that the acquisition strategy should be updated at the phase milestones, as a minimum, for the following reasons:

- Overall progress in attaining program objectives can be measured, giving greater assurance that threat projections can be addresed by the system's performance predictions.

- The updated acquisition strategy can serve to "re-baseline" the program.
- The updated strategy can communicate functional objectives so that contractual requirements for the next phase can be identified.
- The activities for most functional plans are dependent on the particular phase objectives.

To expand on the last point, Table 4-7 lists objectives and concerns, illustrating some of the challenges faced by the Program Manager throughout the acquisition life cycle.

As shown in Figure 4-1, the output of the Update/Modify strategy element serves as the input to the Documentation element, thus completing the cycle. If this overall cycle is considered as a continuous process involving program guidance, planning, and control, the importance of the acquisition strategy can be appreciated. It is reasonable to assert that successful program management results, in fact, from understanding and accomplishing the complete acquisition strategy development and execution process.

4.7 STRATEGY TOOLS

Strategy tools are subelements of Section 4.2, Development, and Section 4.5, Strategy Management. This section addresses some of the analytical processes and tools and techniques that may be useful to program or functional managers in establishing approaches and determining progress toward meeting objectives of the functional strategy. The tools are listed by analytical category. References provided at the end of this chapter contain detailed description and application information.

4.7.1 Risk Analysis

As discussed in Chapter Three, risk provides an overall indicator for evaluating alternative strategies. It can be conceptually defined to consist of uncertainty and damage measures, and it is controllable to the extent that safeguards are incorporated to counter known hazards.

Figure 4-3 presents an overview of the risk assessment process.

Tools and disciplines applicable to risk analysis include:

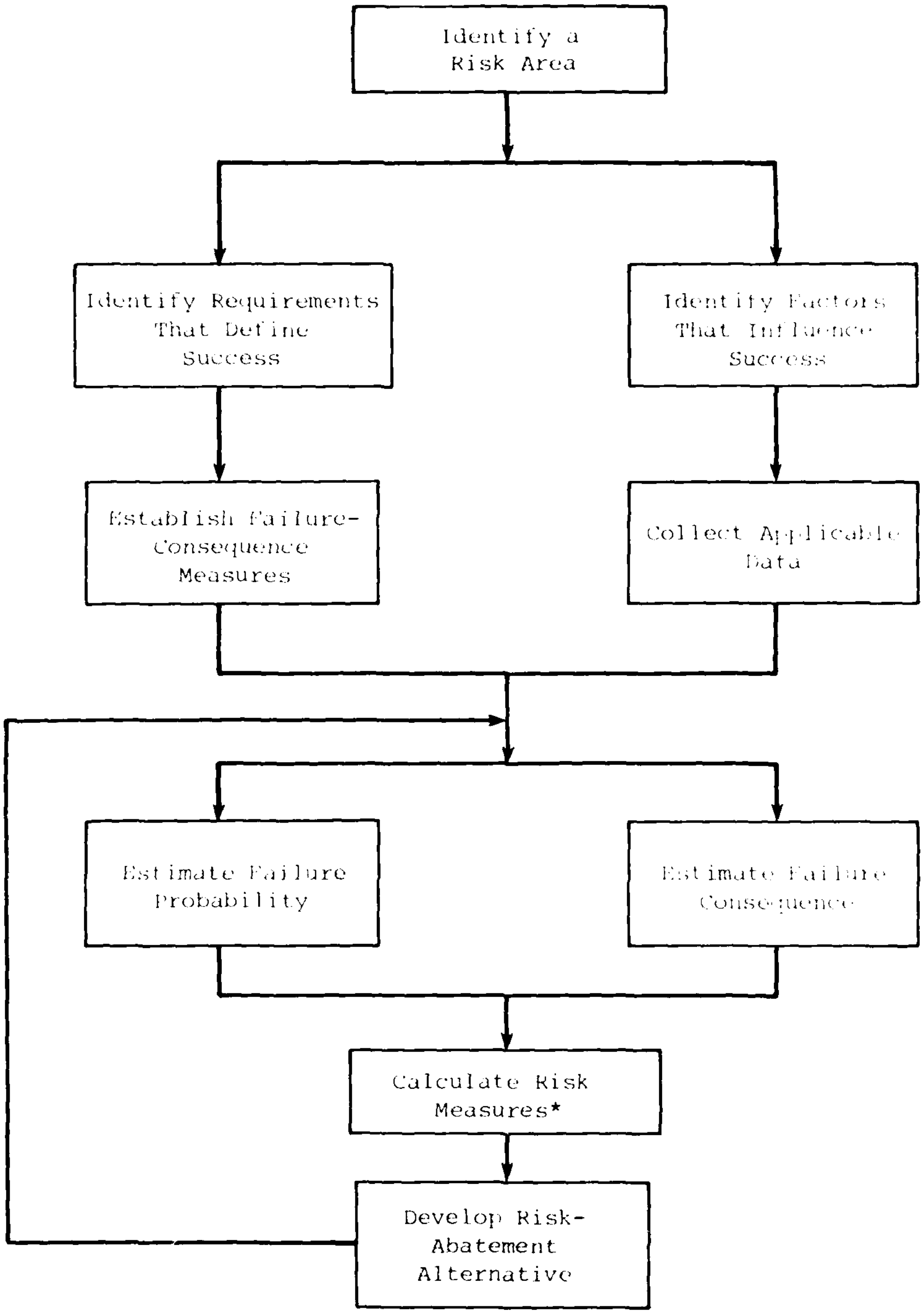
- Probability analysis
- Statistical methods
- Network analysis
- Graphical analysis
- Method of moments
- Estimating relationships
- Decision analysis

TABLE 4-7

ACQUISITION STRATEGY OBJECTIVES AND CONCERNS, BY PHASE

Phase	Examples of Objectives and Concerns
Concept Exploration	Program objectives, structure, resource constraints, and critical assumptions.
Demonstration and Validation	Verification of preliminary engineering, resolution of logistics and interoperability problems, maturity of technology base, and confirmation of need.
Full-Scale Development	Development and test of design, readiness for production, and operational suitability.
Production and Deployment	Equipment acquisition and distribution, unit training, and effectiveness of logistics support.
Operational	Adequacy in meeting threat, need for modernization, and phase-out objectives.

Note: Acquisition strategy updates should be made at least annually and continue until the system is phased out at the end of its operational life.



*If P_F is the probability of failure and C_F the consequence of failure (measured on a 0 to 1 scale), one risk measure is given by the equation $R = P_F + C_F - P_F C_F$.

FIGURE 4-3

OVERVIEW OF THE RISK ASSESSMENT PROCESS

- Delphi techniques
- Work Breakdown Structure simulation
- Logit analysis
- Total Risk Assessing Cost Estimate (TRACE)
- Total Risk Assessing Cost Estimate for Production (TRACE-P)
- Defense Science Board Templates (DoD Directive 4245.7-M)
- Technology state-of-the-art trending

4.7.2 Cost Analysis

In acquisition strategy development and management, cost analysis requires evaluating or estimating future costs. The cost growth often experienced in DoD acquisitions is evidence that the acquisition process is not always successful. Cost growth can occur for many reasons. It can be argued, however, that the cost analysis process may not be providing all of the information for management and acquisition strategy development that is appropriate for minimizing cost growth.

There are a number of cost analysis and estimation procedures. Whichever one is used, a key element is complete, relevant, and accurate data. Such data include detailed descriptions of the system or process under evaluation; associated economic, situational, and environmental factors; and costs and associated information on similar systems. Data quantity is as important as data completeness, relevance, and accuracy. It can be dangerous to estimate the development cost of a missile system by using only one previous missile system's development history.

There are three generic types of cost analysis/estimation procedures:

- Bottom-Up. Estimates are made at the lowest possible level of the system or process, and the expertise of applicable organizations is used. These lower-level estimates are then aggregated and adjusted to account for such factors as integration, overhead, and administrative expenses. This technique, of course, requires fairly complete information at lower levels.
- Comparison. Current cost information on similar systems or processes is collected and modified as appropriate to account for variations from the system or process under evaluation.
- Parametric. A broad base of applicable cost data is analyzed to develop relationships between cost elements and system or process characteristics. These are often called cost estimating relationships (CERs).

All three methods can be used within a single program for which the quality of available information varies. When it can be applied, the bottom-up approach is usually the most accurate but also the most time-consuming and labor-intensive. The comparison method is often used to establish an initial baseline and to calibrate the other methods. The parametric analysis approach is relatively easy to apply if the CERs are available. The accuracy depends on the data quality and representativeness and on the strength of the derived relationships. This method is usually applied early in the program. Tools and techniques useful for cost analysis/estimation include the following:

- Regression analysis
- Service cost models (many available)
- Trend analysis
- Industry cost models (e.g., RCA PRICE for production cost)
- Variance analysis
- Design-to-cost
- Should-cost
- Life-cycle costing
- Will-cost
- Logistics support costing
- Learning curves

4.7.3 Schedule Analysis

In many respects the analysis of schedules has many of the characteristics of cost analysis. Data completeness, accuracy, relevancy, and quantity are important elements. Bottom-up, comparison, and parametric techniques are also applicable. For schedule analysis, there are a number of unique tools and techniques, including the following:

- Gantt and milestone charts
- Line-of-balance (LOB) technique
- Network analysis
- Critical-path method (CPM)
- Program Evaluation and Review Technique (PERT) and its many offshoots, such as Venture Evaluation and Review Technique (VERT) and Computer-Supported Network Analysis System (CSNAS)
- Program reviews and audits
- Microcomputer-based schedule models (e.g., LISA Project)
- Simulation

4.7.4 Decision Analysis

Decision analysis is the process by which choices are made. Much theoretical work has been performed

in developing methods to provide quantifiable measures for evaluating choices. Such methods involve probability theory, statistics, and utility theory. With respect to acquisition strategy, application of the more sophisticated methods is usually limited because of the complex interactions (which make quantification difficult) and the data limitations that usually prevail. Nevertheless, the concepts of decision theory should be used in acquisition strategy development and execution to the maximum extent possible. One simplified approach is to develop a strategy decision matrix for each alternative within a functional strategy. This matrix provides a weighted score for each alternative to yield one evaluation measure.

The following is a step-by-step approach for developing such a matrix (Table 4-8 provides an example):

1. Define the program objectives to be satisfied by the strategic decision. For the example in Table 4-8, four objectives have been identified.
2. Prioritize the objectives by rating the importance of each on a scale of 1 to 10. Normalize these ratings by totaling the ratings of all objectives and dividing each initial rating by the total; then multiply by 100. The sum of the normalized ratings, as shown in the third column of Table 4-8, should equal 100.
3. Identify the strategy alternatives that are under consideration. In Table 4-8, these alternatives are shown as A, B, and C. For each alternative, estimate the probability that it will satisfy the objective on a scale of 0 to 1.0. A 0 value is equivalent to the statement that there is no possibility that the strategy will result in satisfying the objective. A value of 1.0 is equivalent to certainty.
4. For each objective, multiply its normalized rating by the strategy probability and place the result in the appropriate place in the Weighted Score column.
5. For each strategy, sum the entries in the Weighted Score column to obtain its aggregate score for each strategy.

For the example in Table 4-8, Strategy A has a score of 71.5, Strategy B a score of 82.0, and Strategy C a score of 64.75. These scores provide a quantified basis for strategy selection. While this analysis method is simple, developing the initial rating and probability entries can require considerable thought and study, particularly for the strategy probabilities. Such an analysis framework also provides a basis for evaluating risk and the impact of changes. For example, if one of the objectives is to meet an IOC date, and threat conditions change necessitating an accelerated schedule, the strategy success probability will most likely change, resulting in a revised score. In a similar fashion, within each strategy there are a number of strategic components. Sensitivity analysis can be performed to assess the effects of various strategic component approaches on overall scores, and insight is thereby obtained for developing functional plans.

The approaches and tasks applicable to decision analysis include the following:

- Probabilistic analysis
- Mathematical programming
- Bayesian analysis
- Stochastic processes
- Min-max theory
- Matrix analysis
- Utility theory

TABLE 4-8

STRATEGY DECISION MATRIX

Objective	Rating		Strategies					
			A		B		C	
	Initial (1)	Normalized (2)	Probability (3)	Weighted Score (2) x (3)	Probability (4)	Weighted Score (2) x (4)	Probability (5)	Weighted Score (2) x (5)
I	8	40	0.60	24	0.95	38	0.50	20
II	5	25	0.90	22.5	0.50	12.5	0.95	23.75
III	5	25	0.80	20	0.90	22.5	0.60	15
IV	2	10	0.50	5	0.90	9	0.60	6
Total	20	100		71.5		82.0		64.75

- Simulation models
- Game theory
- Expert opinion (e.g., Delphi method)
- Goal programming

4.8 SUMMARY

Acquisition strategy plays a central role in effective program management. Thus it must be well developed, understood, and accepted by all participants in the acquisition process. The Program Manager must be able to communicate his or her strategy as well as develop and execute it. This chapter has presented the steps that a Program Manager might follow in developing, managing, and modifying an acquisition strategy so that it provides a foundation for a well-managed program. It has also listed the analytical tools and techniques for addressing risk, cost, schedule, and decision analyses that might be useful to the Program Manager in formulating the acquisition strategy and directing and controlling the program.

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CHAPTER FIVE

ACQUISITION STRATEGY ISSUES AND ALTERNATIVES

5.1 INTRODUCTION

This chapter describes major strategic issues and alternatives related to systems acquisition. The selection of specific alternatives and approaches for implementing them will encompass the basic elements of the acquisition strategy for the program. The following issues/alternatives are addressed in individual sections (following an overview discussion in Section 5.2):

- 5.3 Competition
- 5.4 Concurrency/Time Phasing
- 5.5 Data Rights
- 5.6 Design-to-Cost
- 5.7 Incentives
- 5.8 Make-or-Buy
- 5.9 Multiyear Procurement
- 5.10 Phased Acquisition
- 5.11 Pre-Planned Product Improvement (P^3I)
- 5.12 Source Selection
- 5.13 Standardization
- 5.14 Test and Evaluation – Reliability Growth
- 5.15 Warranties/Guarantees

For each issue/alternative, a consistent presentation format is followed:

1. Definition
2. Problem Addressed
3. Alternative Forms
4. Advantages
5. Disadvantages
6. Application Criteria
7. Analysis and Development
8. Functional Interfaces
9. Time Line
10. Recent Experience
11. Research and Sources of Information
12. DoD Directives, Military Regulations, and Pamphlets

5.2 OVERVIEW OF THE ISSUES/ALTERNATIVES

The guidelines in the 1981 DoD Acquisition Improvement Program provided the basis for the initial choice of issues included in this chapter. The criteria for including an issue/alternative were based on the level of importance (e.g., competition), a perceived lack of general knowledge of the area (e.g., P^3I), or recent emphasis by Congress or DoD (e.g., warranties/guarantees).

Some of the issues are made broad to permit including a number of strategic areas that might have been considered separately. For example, included within competition are form-fit-function (F^3), directed licensing, leader-follower, and other second-source approaches. Within incentives, the various cost-sharing contract types, including award fees, are considered.

Several of the issues (e.g., design-to-cost and source selection) are not necessarily yes/no propositions. Source selection is always performed, either formally or informally. However, because of the many strategy-related decisions that could be involved in such areas, it was considered worthwhile to include them.

Limitation of the number of issues and amount of detail was dictated by a constraint to make this guide as compact as possible. Therefore, each section presents a set of applicable references that can provide background, data, and guidance on the detailed approaches for functional development and implementation of the alternatives.

5.3 COMPETITION

5.3.1 Definition

Competition is rivalry among companies for markets. In the defense sector competition is imperfect. Under perfect competition qualified companies are relatively small and numerous, entry into the market is not costly, there is a homogeneous product, there is mobility of resources, there is perfect information and many buyers, and companies are price takers—they have no influence on price. These conditions do not apply in the defense sector. In most cases, the defense market is monopsonistic—there is only one buyer. At the major weapon system level there are few sellers who can deliver a particular product, and it is difficult to enter the market. In a concentrated industry with only a few sellers sharing the market, the sellers tend to set the industry price. Thus in the defense market competition has been more concerned with obtaining product quality, production capability, and timely delivery at reasonable cost.

5.3.2 Problem Addressed

The rising costs of maintaining and modernizing our defense establishment are of continuous concern. Competition is viewed as one important approach to constraining cost growth. In any competition there must be competing qualified sources. Competition for a market implies multiple sources and price bidding, and thus a lower cost to the buyer from a qualified source. However, competition may not be on the basis of price only. There is also competition for quality—obtaining a better product whether at a lower or higher price. The buyer has a choice in terms of quality and cost. There may be external factors of great concern to the buyer in addition to price and quality. The Government is concerned with the health and productivity of the defense industrial base and its ability to mobilize and surge: to produce at high volume during periods of emergency if necessary. Thus competition in the defense sector has considered not only price, but also the quality and production capability of the industrial base. There is evidence that the introduction of competition has not always reduced cost overruns, late deliveries, or poor system performance. Very often, in the defense sector, products are obtained under sole-source conditions because of the nature of the product, the technological base of a particular contractor, or the proprietary design of a contractor. The buyer has leverage up to the time the contract is committed to a sole source, but much less leverage beyond that point. The buyer has more leverage over contractors when there is direct competition.

5.3.3 Alternative Forms

Defense competition can take many forms. There may be no competition, for example, where a sole-source procurement is directed or a selection is made because of the nature of the product and the availability of qualified sources. Where there is direct competition, it may involve two or more companies, and it may occur during research, development, or production of a product.* Two generic forms of competition are recognized in military acquisition:

- Design Competition. Two or more companies develop conceptual or design approaches, one or more of which will be used for the production contract. The competition can be extended through the Demonstration and Validation phase and into the Full Scale Development phase to obtain prototype performance verification and to provide a natural competition for the production contract. Typically, in large programs design competition ceases at Full Scale Development.
- Production Competition. Two or more companies bid to secure all or part of a production contract. Thus there may be a winner-take-all competition or the production may be split between two contractors. The competitors may have participated in the program prior to the first production contract, or one or more may have been brought in through a second-sourcing strategy.

A typical competitive strategy might then proceed as follows:

- Concept Exploration Phase. Select two or more contractors to develop system and operational concepts.
- Demonstration and Validation Phase. Select two contractors to develop prototype models to be used for "fly-off."
- Full Scale Development Phase. Select one contractor for FSD, with the RFP stipulating requirements for eventually bringing in a second source.
- First Production. Enter into sole-source contract that includes "deliverables" for eventual second-sourcing.
- Subsequent Production. Select one or more contractors using the selected second-source approach.

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*The FAR (Part 34—Major System Acquisition) specifies that "The Program Manager shall, throughout the acquisition process, promote and sustain competition between alternative major system concepts, as long as it is economically beneficial and practicable to do so."

There are many variations of this process. An overview of the various competitive strategies is provided in Figure 5-1.

The approaches to establishing second sources for production have received the greatest attention, for it is in this phase that the major expenditures are made during acquisition. The following methods have been identified:

- Form-Fit-Function (F^3). Only functional requirements and size, weight, and interface parameters are specified, permitting one "black box" to replace another. It is applicable with break-out (see Section 5.13).
- Technical Data Package. Data are purchased to enable qualified contractors to produce the equipment (see Section 5.5).
- Directed Licensing. This is similar to leader-follower except that the leader company is compensated for technology transfer through royalty or licensing fees.
- Leader-Follower. The system developer or sole-source producer furnishes assistance to a follower company to establish the latter as a second source. Since the leader company has a natural reluctance to lose its sole-source position, contractual commitments must generally be made at an appropriate time to ensure the viability of this approach.
- Contractor Teams. Teams of individually competent contractors bid for the development contract, thus providing multiple qualified sources for the system during the production phase.
- Break-Out. A critical subsystem or component is selected for competitive production in out-year buys. A subsystem component that is broken out may become GFE.

Competition by several companies for the same system should always be considered in new systems acquisition. It is not always implemented, for a variety of reasons. However, there can also be indirect competition in that the mission need can be met by a substitute product. Examples are the C-5B and C-17 transports to meet the airlift mission, and KC-135 re-engine and KC-10 tankers to meet the air refueling mission. Some leverage is thus maintained over contractors in that these mission competitors do compete for the same funding.

5.3.4 Advantages

Advantages of competition include:

- Obtaining a lower price for a product
- Obtaining a higher-quality product
- Expanding the industrial base
- Enhancing surge capability in an emergency
- Providing more than one source for product innovation
- Stimulating research and development
- Encouraging an incumbent to be more cost-conscious
- Encouraging an incumbent to be more receptive to the concerns of the buyer and to address criticisms

5.3.5 Disadvantages

Disadvantages of competition include:

- Increased initial cost due to duplication of the work to administer contracts, prepare to produce a product, or accomplish a specific task
- More complex and costly support of duplicate products in the field
- Variations in quality between competitive products
- Time and cost to educate second source (can delay fielding of future units)
- Weakening of any working relationship that exists between a specific contractor and the Program Office

5.3.6. Application Criteria

Competition should be applied where there is a reasonable prospect for achieving a lower-cost product or a higher-quality product or enhancing the industrial base. Applying competition in a particular situation implies that companies are qualified to perform the task or will be given the opportunity to learn; that they can meet schedule, cost, and product quality criteria; and that they are willing to commit their resources to the task. In the defense sector the initial costs of competition can outweigh any cost advantage downstream in dealing with technologically advanced and highly complex weapon systems that may cost billions of dollars to develop and produce. Competition at component or subsystem levels is more appropriate in such cases.

The GAO, in observing a decline in price competition, suggested a set of questions that Program Managers should consider before deciding on sole source:*

*GAO Report PLRD-81-45 of July 29, 1981, *DOD Loses Many Competitive Procurement Opportunities.*

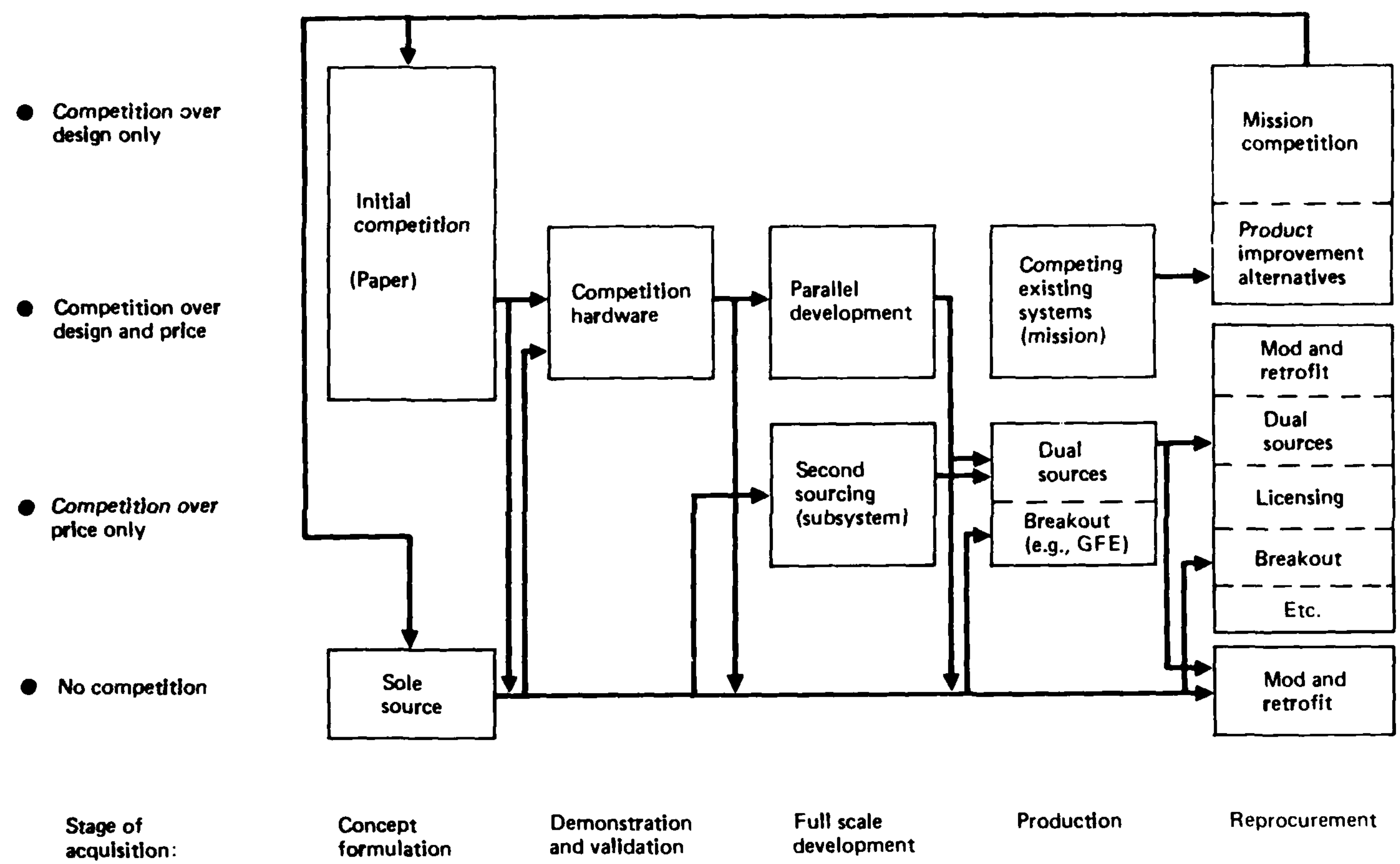

FIGURE 5-1

TYPES OF COMPETITION (REFERENCE 3)

1. What are the procurement's minimum requirements? Material evidence should be presented verifying these minimum requirements.
2. What unique capabilities does the proposed contractor possess which make it the only company capable of meeting these minimum requirements?
3. Was a market search or other type of solicitation conducted? Material evidence should be presented verifying that such a search was conducted and that the proposed contractor was the only company meeting the procurement's minimum requirements.
4. Was the item or service previously procured? If yes, was it from the same contractor? If this is a continuation of a previous effort by the same contractor, demonstrate why no other sources of supply are available.
5. Is there a technical data package, specification, engineering description, statement of work, or purchase description available which is sufficient for competitive procurement? If not, is one being developed? If not, why not? How much lead time would be required to develop it? Has any cost-benefit analysis been conducted to determine whether it is advantageous to the Government to buy or to develop such information? If not, what evidence is available to demonstrate why this analysis is not needed?
6. Can individual components of the procurement be competitively procured? If so, what steps have been taken to do this?
7. Does the procurement result from an unsolicited proposal? If so, who first described the problem to be addressed by the unsolicited proposal? Demonstrate why the proposed contractor is the only one capable of performing the service or providing the item.
8. What material evidence exists that the Government would be injured if the non-competitive procurement is not made? This includes estimates of additional costs incurred and criticality of schedules (including when the procurement need was first identified, reasonableness of delivery schedules, etc.).
9. What steps are being taken to foster competition in subsequent procurements of this product or service?

Major considerations in achieving competition are the capacity and utilization of industry and individual contractors and where the program fits in a company's long-range planning. How "hungry" is the company and how does it view program impact on future business? What are economic conditions in the industry, in the company, and in the division of the company? Obtaining such information will normally involve some effort on the part of the program office. In one major program, a financial model of the prime contractor was developed to help the program office better understand the prime contractor motivations.

When two companies compete during production, it should be because there are incentives to provide a less costly or higher-quality product or to enhance the industrial base. If a company has won the production contract through its performance during development, but it is inefficient in production, then competition might create the incentive for that company to become more efficient. Competition can affect profit, efficiencies in the production process, and efficiencies through facilities investment. Competition might serve as a check on excessive salaries and overhead, predilections toward cost overruns, and the obsolescence of production facilities. The threat of competition can also affect a sole-source supplier's attitude toward the customer.

5.3.7 Analysis and Development

A thorough analysis is required so that appropriate cost elements can be understood and compared before decisions concerning price competition are made. When a second source is being established to compete with an existing source, nonrecurring investment may be required for facilities, for technology transfer (data package), and for an educational production lot (learning). There may also be a cost associated with the fact that the original company is no longer producing all of the articles originally programmed (some of which will be produced by the competitor), thus lowering its quantity and production rate (see below). The ability to select one contractor or divide the buy between two contractors will depend on the level of detail of the data available for analysis in proposals and on previous experience with the contractors' cost and quality credibility. Again, the final decision cannot be made on the basis of cost savings only.

There is a need for techniques that can provide an understanding of contractor abilities to produce at certain prices and rates. Knowledge of the contractor learning curve and the impact of production rate on the learning curve is critical, as is knowledge of the factors that cause *translating* and *rotating* of the learning curve. Translation is movement of the learning curve parallel to the original learning curve position. Competition would cause the learning curve to move down due to pressure on various factors such as profit margins, overhead rates, production efficiencies, management improvements, investment, and

others. Rotation can also be affected by the factors cited above and also by the rate of production for the units ordered. Rotation is the movement of the learning curve about a fixed point. It is also necessary to express costs in constant dollars and to calculate net present value in making comparisons.

An understanding of costs is particularly critical in production competition, where it is necessary to start up a second company after one company has developed the product. The elements that must be addressed to assure a valid competition analysis are:

- Extrapolation of sole-source learning curve
- Conversion to constant dollars
- Estimation of nonrecurring costs (including technology transfer and start-up)
- Translation of learning curve
- Rotation of learning curve
- Adjustment for production rate
- Estimation of net present value

Figure 5-2 depicts several of the competition analysis elements. If a quantity (Q_2-Q_1) is to be procured, Point B is obtained by extrapolating the incumbent contractor's learning curve from Point A. Translation or rotation of that learning curve might be expected, because of competitive pressures. The figure shows translation to A′-B′ and then rotation to B″ if the effect of competitive pressure and production rate is to lower costs. However, a rotation to B‴ from A′ might occur if a split buy would result in the procurement of substantially fewer units per year from this contractor thereby raising costs. The costs of production are estimated by comparing the cumulative average unit cost at B″(or B‴) with B (not with A) for the quantity to be procured, and adding the nonrecurring costs. The analysis must include: all data and comparisons in constant dollars; any investment required to transfer technology and to start up or educate the second source; and all streams of future funding, expressed in net-present-value dollars. There is an obvious need for data that are accurate, timely, high-quality, not biased, and complete.

A number of models for analyzing competition have been developed. One simplified approach is a second-sourcing selection model originally appearing in Reference 22. This reference provides a set of check lists that compare the applicability of various second-sourcing methods with each of 14 decision variables. Table 5-1 lists these variables and summarizes their effect on second-sourcing strategy selection. Tables 5-2 and 5-3 summarize the second-sourcing methods for the first production phase and for reprocurements, respectively. A "+" entry in the table indicates

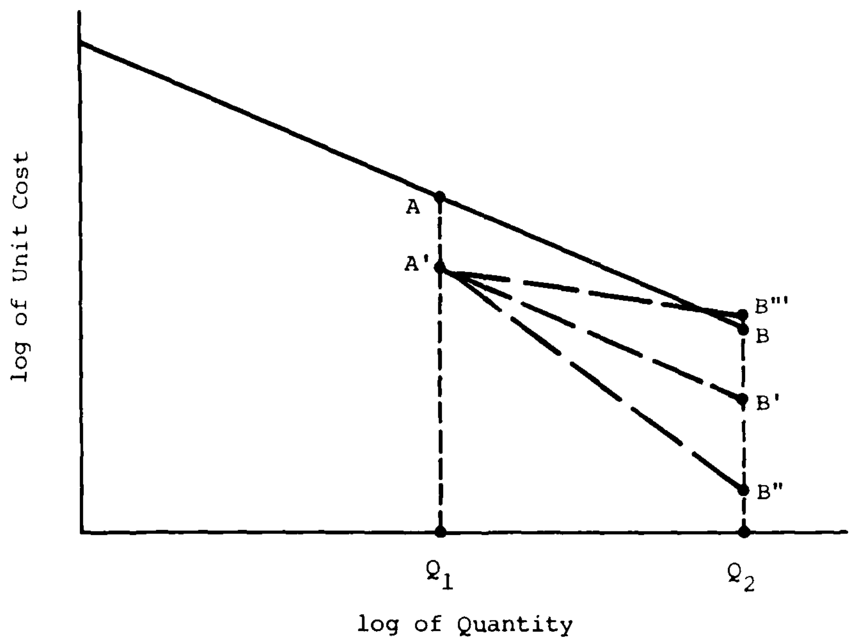

FIGURE 5-2

IMPACT OF COMPETITION ON COST-QUANTITY

TABLE 5-1

SUMMARY OF DECISION VARIABLES AFFECTING SELECTION OF A SECOND SOURCING METHOD

Variable	Effect
Quantity of Production	Low quantities make second sourcing difficult, especially for technical data package.
Duration of Production	Qualifying a second source takes time. Licensing and leader-follower are particularly unsuitable.
Slope of Learning Curve	When steep learning is involved, any split of production quantities will tend to increase costs.
Technical Complexity	The more complex the system, the more difficult it is to second source. Contractor teaming is especially effective in bringing complementary technologies together.
State of the Art	Similar to technical complexity.
Other Government and Commercial Applications	If there are significant alternative uses for the system, original producer will probably create barriers to second sourcing.
Degree of Privately Funded Research and Development	Second sourcing success limited if critical elements are proprietary.
Special Tooling Costs	Provides original producer strong competitive advantage if costs are very high.
Cost of Transferring Unique Government-Owned Tooling	Equal weighting for all alternatives.
Capacity of the Developer/Original Producer	The more capacity the original producer has, the less likely second sourcing can be effective.
Maintenance Requirements	If second sourcing introduces variations in field maintenance, its viability decreases.
Production Lead Time	The longer the lead time, the smaller the advantages of second sourcing.
Degree of Subcontracting	If many subcontractors are involved, the advantages of second sourcing are diluted.
Contractual Complexity	The more complex the contractual relationship with the original producer, the more barriers there are to second sourcing.

TABLE 5-2

SECOND SOURCING METHOD SELECTION MODEL: FIRST PRODUCTION

Variables	Methodology				
	Form-Fit-Function	Technical Data Package	Directed Licensing	Leader-Follower	Contractor Team
Quantity					
High	+	+	+	+	+
Medium	+	+	0	0	+
Low	0	0	-	-	0
Duration					
Long	+	+	+	+	+
Medium	+	+	0	+	+
Short	0	0	x	x	0
Learning Curve					
Steep	-	-	-	0	0
Flat	+	+	+	+	+
Technical Complexity					
High	0	x	+	+	*
Medium	+	-	+	+	+
Low	+	+	+	+	+
State of the Art					
Yes	0	x	+	+	*
No	+	+	+	+	+
Other Application					
Yes	+	0	+	0	+
No	+	+	+	+	+
Degree of Private R&D					
High	0	x	0	x	-
Low	+	0	+	+	+

Key:

+ = Strong applicability
- = Weak applicability
* = Particularly well suited

0 = Neutral applicability
x = Particularly inappropriate

(continued)

TABLE 5-2 (continued)					
Variables	Methodology				
	Form-Fit-Function	Technical Data Package	Directed Licensing	Leader-Follower	Contractor Team
Tooling Costs					
High	-	-	-	-	x
Low	+	+	+	+	+
Government Tool Transfer Cost					
High	0	0	0	0	0
Low	+	+	+	+	+
Contractor Capacity					
Excess	-	-	-	-	-
Deficient	+	+	+	+	+
Maintenance Requirement					
Significant	x	0	0	0	0
Minimal	+	+	+	+	+
Production Lead Time					
Long	-	-	-	-	-
Short	+	+	+	+	+
Degree of Subcontracting					
Heavy	0	-	-	-	-
Light	+	+	+	+	+
Contractor Complexity					
Complex	-	-	-	-	-
Simple	+	+	+	+	+

Key:

+ = Strong applicability
- = Weak applicability
0 = Neutral applicability
x = Particularly inappropriate

TABLE 5-3

SECOND SOURCING METHOD SELECTION MODEL: REPROCUREMENT

Variables	Methodology				
	Form-Fit-Function	Technical Data Package	Directed Licensing	Leader-Follower	Contractor Team
Quantity					
High	+	+	+	+	+
Medium	+	0	0	0	+
Low	0	x	-	-	-
Duration					
Long	+	+	+	+	+
Medium	+	0	0	0	0
Short	0	x	x	x	-
Learning Curve					
Steep	0	0	0	0	0
Flat	+	+	+	+	+
Technical Complexity					
High	0	x	+	+	*
Medium	+	-	+	+	+
Low	+	+	+	+	+
State of the Art					
Yes	0	x	+	+	*
No	+	+	+	+	+
Other Application					
Yes	+	-	+	0	+
No	+	0	+	+	+
Degree of Private R&D					
High	0	x	0	x	0
Low	+	0	+	+	+

Key:

+ = Strong applicability — 0 = Neutral applicability
- = Weak applicability — x = Particularly inappropriate
* = Particularly well suited

(continued)

TABLE 5-3 (continued)					
Variables	Methodology				
	Form-Fit-Function	Technical Data Package	Directed Licensing	Leader-Follower	Contractor Team
Tooling Costs					
High	-	-	-	-	x
Low	+	+	+	+	+
Government Tool Transfer Cost					
High	0	0	0	0	0
Low	+	+	+	+	+
Contractor Capacity					
Excess	-	-	-	-	-
Deficient	+	+	+	+	+
Maintenance Requirement					
Significant	x	0	0	0	0
Minimal	+	+	+	+	+
Production Lead Time					
Long	-	-	-	-	-
Short	+	+	+	+	+
Degree of Subcontracting					
Heavy	0	-	-	-	-
Light	+	+	+	+	+
Contractor Complexity					
Complex	-	-	-	-	-
Simple	+	+	+	+	+

Key:

+ = Strong applicability
- = Weak applicability
0 = Neutral applicability
x = Particularly inappropriate

strong applicability to the variable shown. A "0" indicates neutral applicability, and a "-" indicates weak applicability. The "x" indicates that the approach is particularly inappropriate, while the "*" indicates that it is particularly well suited.

5.3.8 Functional Interfaces

Competition is of primary interest in the business/financial strategy at the functional level but can interface in one way or another with all of the other functional strategies and plans, depending on the reason for and type of competition. All interfaces need to be addressed in developing the acquisition strategy.

Functional Interfaces:
Competition

Design	X
Test and Evaluation	X
Production	X
Deployment	X
Personnel/Organization	X
Schedule	X
Business/Financial	Primary
Management Information	X
Facilities	X

5.3.9 Time Line

The overall competition strategy should be included in the initial acquisition strategy. Specific competitive approaches must be identified before the start of each phase, and the implementation must be carried out during that phase. In general, the longer the contractors are aware of the competitive opportunity, the more likely the competition will be effective.

Time Line: Competition

Milestones

	0	1	2	3
Decision	•	•	•	•
Implementation	—	—	—	—

5.3.10 Recent Experience

In general, there is a lack of detailed data for analysis of competition, and there have been inconsistent approaches to analyses of the data that were available. A survey of current Program Managers conducted during development of this guide indicated that 95 percent of the programs considered competition and 80 percent incorporated it into their acquisition strategy. Of the programs using competition, 79 percent had positive experience and 6 percent had negative experience. A number of studies on the results of competitive procurements have been conducted recently. They present mixed results with regard to the impact of competition.

In general, it has been implied by earlier studies that competition might save 20 to 50 percent of the cost to the Government. Several procurements of specific electronic equipment have apparently captured these high savings. However, in many cases, particularly procurements of major subsystems, such savings have not been achieved. There are many reasons for this, one being that the cost to the Government to establish a second supplier for a costly subsystem or system can be more than the savings to be achieved in the competition. Start-up cost has been ignored or seriously underestimated in many studies. However, the ability to have second sources producing a product (if the total production is of sufficient quantity and the competition can extend over a sufficient period of time) appears to provide an economic benefit in the long term.

For programs in which the cost effects of competition have been analyzed, results have ranged from a 36 percent additional cost to a 67 percent saving, depending on the cost to qualify a competitor, methodology ground rules, type of equipment, quantity purchased, and rate of production. For one program (Shillelagh) analyses ranged from a 10 percent additional cost to a 10 percent saving when costs were calculated by different methods. When considering competition in procurement the Program Manager must, of course, do as complete an analysis as possible given the availability of data. Sensitivity analyses of major assumptions is essential.

A wealth of experience resides within each service in the form of acquisition advisory panels, senior officials, program offices, and competition advocates.

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c. DODD 5000.1, Major System Acquisitions, 29 March 1982.
d. DODI 5000.2, Major System Acquisition Procedures, 8 March 1983.
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5.4 CONCURRENCY/TIME PHASING

5.4.1 Definition

Webster's defines concurrency as activities happening together in time or place. The Defense Science Board Report of The Acquisition Cycle Task Force (1978) defined concurrency as "the conduct of steps leading to production for inventory before the end of the Full Scale Development time span." Thus, concurrency in DoD is generally placed in the context of the overlap of activities constituting at least part of full scale development, transition to production, achievement of production rate, and initial deployment of the system. Concurrency can also occur through elimination of a phase or overlapping of phases in the acquisition process.

5.4.2 Problem Addressed

The acquisition cycle has been lengthening over the past decades, and concurrency is one approach that is usually considered to shorten the time required to achieve an earlier Initial Operational Capability (IOC). However, the lengthening of the acquisition cycle has not been due to a lengthening development phase, but rather to longer times prior to development and longer production spans after development. Concurrency that requires the overlapping of Full Scale Development activities in design, test and evaluation, and production and deployment can increase the risks of not achieving performance, schedule, and cost objectives. This is true particularly when testing and initial production and fielding of the equipment overlap considerably and there is not sufficient time to use test results to correct design deficiencies.

One problem in determining the extent to which concurrency can be applied (how much compression in the schedule can be tolerated) is understanding the difficulty of the program before starting FSD. Consideration should be given to technology advances sought and complexity of the system relative to the desired IOC date and the amounts and types of testing required to reduce design uncertainty. On the one hand, IOC is desired as early as possible. On the other hand, sufficient time must be allowed for the FSD activities leading to IOC. It may not be a matter of more money and people to shorten the time; certain activities cannot be accomplished very much sooner no matter how extensive the resources applied.

The transition from Full Scale Development to Production and Deployment is the most difficult period to manage, and thus a great burden is placed on the Government and industry management teams to accomplish all required activities within constrained schedule and cost. The normative approach is to conduct design, test, production, and deployment in a sequential manner, particularly testing leading to production, so that the information available from testing can be fully utilized to mature the design and finalize the production article. In this sequential case the total time can be much too long compared with the desired IOC if there is urgency in fielding the system. Compromises concerning activities and durations are based upon past experiences of similar or analogous activities.

5.4.3 Alternative Forms

Concurrency is the overlapping of design, testing, production, and deployment activities. The overlapping and elimination of phases in the acquisition cycle, as well as overlapping or eliminating activities within a phase, are also possible choices based on the urgency of need or maturity of the system. Possible alternatives are shown in Figure 5-3. A realistic technology assessment and allowance for critical-time-duration activities (long pole in the tent) is the key element in planning a program with a high degree of concurrency between or within phases of the acquisition process. The pacing subsystem(s) and activities must be identified, and adequate time must be allowed for design and test. During Full Scale Development, there must be a commitment to production from the outset (e.g., a National need), because test, production, and deployment decisions must be made much earlier during design and testing activities. A realistic evaluation of available technology and previous experience is critical. It may be necessary to simulate designs before testing in order to speed design decisions. Early testing is critical to the verification of design uncertainties but requires hardware delivery and test set-up, which can require considerable additional time and early resources.

In the commercial sector, commercial airplane programs are started only when there is a market opportunity and advance orders are received and thus there is a commitment to production. It is urgent to proceed to production, even though it is understood that some changes will occur later in production and that changes cost money. This element of cost must be accepted at the outset and yet must be carefully controlled to keep costs down. In the commercial sector these changes are considered less costly than holding to low production rates while correcting deficiencies, and thus the drive is to attain an efficient

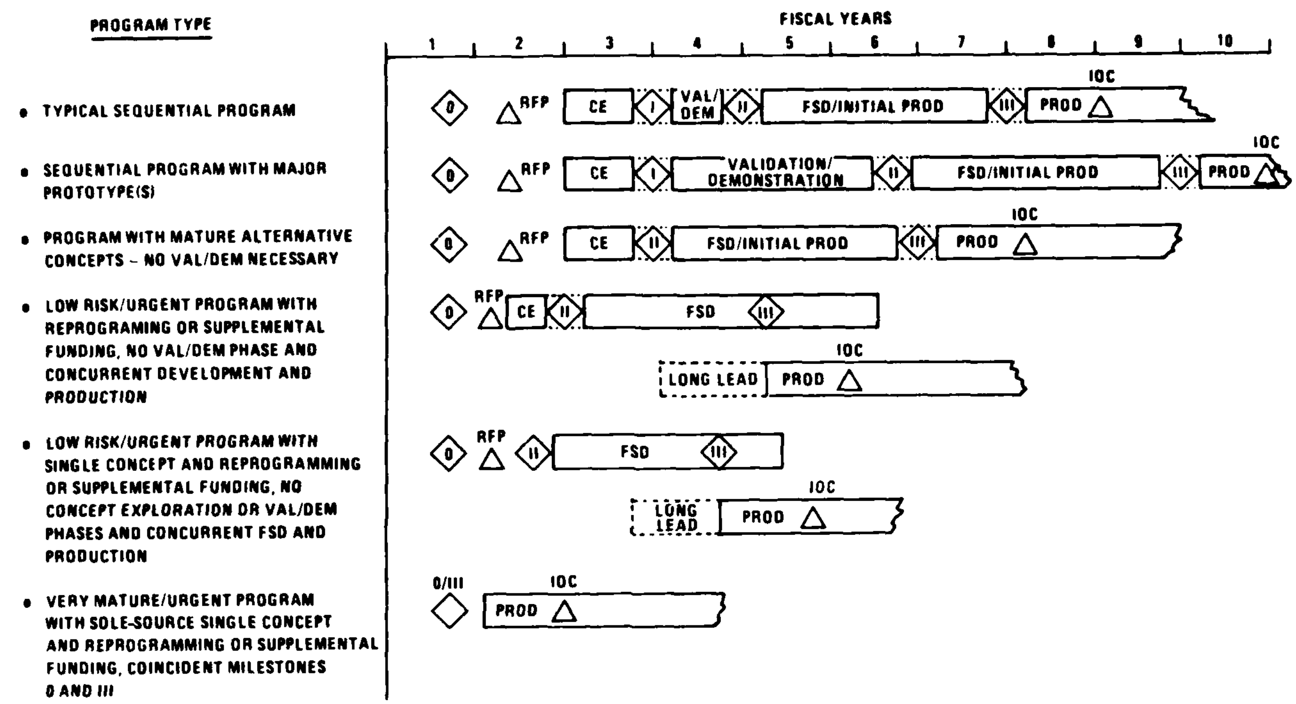

FIGURE 5-3

EXAMPLES OF TAILORED ACQUISITION STRATEGIES

production rate as early as possible to maintain program viability. At the same time, a keen awareness of technology, and the cost of schedule slippage is required. The commercial approach produces test articles as close as possible to production articles; therefore, production will be a reasonable continuation of producing the test articles. Commercial practice also puts a stop to performance-oriented and cosmetic engineering changes much earlier and introduces significant performance improvements in block changes later in the program.

5.4.4 Advantages

The principal advantage of concurrency is the achievement of an earlier operational capability. Concurrency can also result in lower cost for that shorter period, provided program objectives are achieved up to operational capability. Another important advantage of concurrency is that design maturity and production start-up problems become visible earlier with increased earlier testing. In addition, production articles are closer in configuration to test articles, if the test articles turn out to be acceptable in terms of performance and unit cost. There can be an advantage in work force continuity and motivation if the program is perceived as important to the National interest.

5.4.5 Disadvantages

Concurrency introduces substantial risk of occurrence of performance shortfall, schedule slippage, and cost growth, particularly if the technology is advanced and the system is complex. Technology assessment is a critical element in the appropriate application of concurrency. Risk identification, assessment, and management are essential elements of a program to deal with risk introduced by concurrency. How complex and difficult will the program be? If difficulties arise during FSD, or if deficiencies must be corrected in the field, large cost increases (as well as schedule slippage) can occur; and if deficiencies are serious, system operational availability, readiness, and performance can suffer. This has been found to be true in the commercial sector as well as in the Defense industry. A recent study of petroleum and chemical industry pioneer process plants found that the underestimation of technological advance and complexity were determining factors in poorer plant performance, schedule delays, and substantial cost increases (Reference 5).

5.4.6 Application Criteria

Concurrency is applied to protect important milestones or to compress the overall schedule. The primary criterion for applying concurrency to technologically advanced systems is that there is a National need for the program (an early operational capability date is critical) and that difficulties encountered during the program and any associated cost increases are less important than getting the system into the field. This was the case with the Air Force Ballistic Missile Programs and the Navy Fleet Ballistic Missile Programs. A critical element in determining the degree of concurrency is a careful assessment of the technologies to be applied to all major components of the system. It may be necessary to allow concurrent alternative solutions and product improvements (P^3I) to hold to the operational capability date.

If the system is not technologically advanced, there are options concerning whether certain activities shall be conducted in parallel or not at all. The determining factor then is to save time and money.

5.4.7 Analysis and Development

For the most part, the planning of a concurrent program makes use of guidelines, rules of thumb, and experience with similar systems to estimate the time required for each activity, the extent to which various activities can be overlapped, and the critical pacing items in the development program. Critical-Path Method (CPM) and PERT/VERT techniques have been found to be valuable in estimating probabilities for the times required for various events; they can track such events in the program. Hard decisions are required on what types of testing to conduct; how much testing is enough; the degree of risk in technological advancement; and trade-offs between performance, early operational capability, maturity of the design, when to initiate production, and total costs. There must be continuous analysis in identifying and controlling risks during transition from development to production and deployment. A risk management system that addressed technical risk as well as schedule and cost risks would be an extremely valuable tool for the Program Manager.

5.4.8 Functional Interfaces

Concurrency is primarily associated with scheduling strategy. However, it is so critical that it interfaces with all other functional strategies. Its implications for the program must be well understood, and commitment to a strategy using concurrency must be specified prior to the Full Scale Development phase.

Functional Interfaces:
Concurrency

Design	X
Test and Evaluation	X
Production	X
Deployment	X
Personnel/Organization	X
Schedule	Primary
Business/Financial	X
Management Information	X
Facilities	X

5.4.9 Time Line

Decisions on the degree of concurrency in Full Scale Development (and overlap with Production and Deployment) must be made before Requests for Proposals are issued for that phase. The time line below shows dotted lines prior to Milestone I, because consideration must be given to concurrency at the earliest time possible (and indeed an early phase may be eliminated or compressed), but the final decision for currency during FSD will be prior to proposals for FSD. Concurrency is then implemented during FSD and into Production and Deployment.

Time Line: Concurrency

Milestones

	0	1	2	3
Decision	●····●			
Implementation	·········————			

5.4.10 Recent Experience

For almost every major weapon system some concurrency has been applied in scheduling the overlapping of design, test and evaluation, and production and deployment activities. At issue is the degree of concurrency and the commitment of large quantities of resources and money to following activities before completion of a prior activity. In programs of National importance, such as the Air Force Ballistic Missile Programs or Navy Fleet Ballistic Missile and Nuclear Submarine Programs, several approaches to particular problems were taken or multiple contractors were funded for risky components or subsystems. The National need took precedence over the concern about additional costs.

Recent research has indicated that the time intervals prior to initiation of FSD and after production begins are primarily responsible for the lengthening acquisition cycle (Reference 7). The time to accomplish weapon system FSD has not changed much.

An approach that might be appropriate for important technologically advanced programs that are constrained by budgets is to produce articles at a low rate initially while continuing test and evaluation activities so that design deficiencies can be corrected with a minimum number of existing production articles requiring change. (This phased-acquisition approach is discussed later in this chapter.) Some early production experience is being achieved, while block changes can be introduced in the production process when they are ready. (This is also an approach to introducing a leader-follower concurrent production source later in the program, when the basic production source has been established.) A recent Acquisition Strategy Survey of more than 40 programs indicated that four out of every five programs used concurrency in some form and three out of four of those using concurrency considered it beneficial. Programs that have recently used concurrency in some degree include:

Army

Hellfire	Apache
Bradley Fighting Vehicle	Hawk
	MLRS
Black Hawk	JTACMS
M-1 Tank	

Navy/Marines

SLCM	AV-8B
Torpedo Mk 50	JVX
DDG-51	Harpoon

Air Force

M-X	GLCM
ALCM	T-46
B-1B	F-16
AMRAAM	

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e. DODD 4245.7, Transition from Development to Production, January 1984.

5.5 DATA RIGHTS

5.5.1 Definition

Data rights are the limitations placed on the Government in using technical data delivered as part of a contract. There are two basic forms of data rights:

- Unlimited Rights. The right to use, duplicate, or disclose technical data in whole or in part in any manner and for any purpose whatsoever, and to direct or permit others to do so.
- Limited Rights. The right of the Government, or others on behalf of the Government, to use, duplicate, or disclose data, but not outside the Government without written permission.

It is the general policy of the Government to acquire data with unlimited rights when the data result directly from work on a Government contract. Limited data rights may apply when the unpublished technical data pertain to items, components, or processes developed at private expense. Contractors generally consider such data proprietary.

The DoD policy on data is to acquire only such technical data rights that are essential to meet Government needs. The Program Manager must determine whether the expense of acquiring, storing, and maintaining data is justified.

5.5.2 Problem Addressed

For any contract, the Government has a legitimate need for data to support such functions as operation, maintenance, training, standardization, and logistics support. Of primary concern is the purchase of data to provide the capability to produce the item by sources other than the original manufacturer (usually called a technical data package [TDP]).

When a sole-source production contract is awarded, the Government is placed in the position of having to depend on the contractor for additional units, spares, and modifications. To avoid such complete dependence, strategic planning can include such options as competitive production, leader-follower, and licensing. Data rights may be required to exercise options for avoiding sole-source dependence. If the contractor cannot or does not want to produce the equipment, the purchased data can be used to solicit other sources, or possibly the equipment can be produced in Government facilities. When the data being considered are proprietary, the expense of acquisition will generally be higher, especially if the Government sees a need for acquiring unlimited rights.

5.5.3 Alternative Forms

There are two basic forms of data rights for technical data packages: unlimited rights and limited rights. For software, there is a form called restricted rights.

There are a number of issues associated with data rights. It may not be clear if data are proprietary, as when a contractor has performed work using its own funds but may have also had contracts in a similar area. A subcontractor may refuse to deliver data pertaining to its product even though all prime contractor data fall in the category of unlimited

rights. A process called Predetermination of Rights in Technical Data is used to identify and establish agreements on proprietary data.

Software is considered technical data. Restricted rights in computer software apply to such data when the software use is limited to one computer (or backup) identified in the software license or agreement.

Another related issue is patent rights. In its simplest form, it offers two possibilities:

- The contractor retains patent rights, and the Government receives a nontransferable license to use the patent.
- The patent rights are retained by the Government, and the contractor receives a nonexclusive license to use the patent.

For patents developed under contracts, a predetermination process following the check list guidelines in DAR 9-701.3 is used to decide if the Government will retain patent rights or offer the contractor that opportunity. Generally, Government contractors can use inventions patented by others if necessary for Government contract work without risk of suit for patent infringement. However, they are subject to possible royalty charges if the Government does not have any rights to the patent.

Two related issues concern NATO RSI licensing and the Freedom of Information Act. United States companies find it difficult to obtain proprietary rights and to acquire European patents on equipments scheduled for NATO RSI production. However, because of the data rights policies of European countries, European contractors can obtain patent and technical data rights in both Europe and the United States much more easily.

The Freedom of Information Act is a potential source of concern for contractors. The Government has the sole authority to bar release of proprietary information under this Act (Exception Four). Recent court decisions concerning the Act and the lack of any control by the contractor could jeopardize the contractor's competitive position. Contractors may therefore be reluctant to provide complete data.

5.5.4 Advantages

If data rights are being acquired to permit introducing a second production source, the obvious advantage is in achieving the potential for competition for out-year buys. A secondary advantage lies in reducing dependence on a single manufacturer for equipment, spare items, training, overhaul, and other activities for which detailed design and production data might be important.

5.5.5 Disadvantages

The major disadvantage of data rights is cost. Even when the contractor agrees to unlimited rights, securing and maintaining such data can involve substantial resources. A more subtle problem exists in the possible false assurance that can be imparted by data rights. In many instances enormous difficulties are encountered by a second source in trying to manufacture items using data purchased during the initial production period. Examples of difficulties include changes in design not included in the data package, reference to proprietary materials and processes, and lack of specific experience pertinent to the manufacture of the item.

5.5.6 Application Criteria

The DAR (Section 9-202.2[f]) lists the conditions under which the Government may negotiate for unlimited rights in technical data in situations that would normally call for limited rights. These conditions should apply, with some minor modifications, to most decisions concerning the purchase of data. They are as follows:

- There is a clear need for reprocurement of the item.
- There are no available alternative items or processes.
- The item can be manufactured by a competent manufacturer without the need for additional data that cannot be reasonably purchased.
- Saving in reprocurement using the purchased data will exceed the data cost and rights therein.

5.5.7 Analysis and Development

The basic issue of a data rights strategy is summarized in the following excerpt from the DAR (Para. 9-202.1):

> ". . . when the Government pays for research and development work which produces new knowledge, products, or processes, it has an obligation to foster technological progress through wide dissemination of the new and useful information derived from such work and where practicable to provide competitive opportunities for supplying new products and utilizing the new processes. At the same time acquiring, maintaining, storing, retrieving, and distributing technical data in vast quantities generated by modern technology is costly and burdensome for the Government."

The basic approach to determining the form and extent of data rights is as follows:

1. Determine the potential need for the data. Will the item be reprocured in the future? For how long? Are there alternatives (e.g., licensing, dual production, leader-follower, competitive products)? How important is having a second source?
2. Assess the potential cost. What will the data package with unlimited rights cost? With limited rights? What are the storage, maintenance, and retrieval costs?
3. Assess the potential benefit. Will the data rights package be usable for manufacture by an outside source? A Government facility? Can the competition made possible by the data reduce costs significantly?

Several alternatives are available to the Program Manager to aid in the evaluation and implementation process:

- Make the data rights a separate item in the contractor proposal so that realistic cost analysis can be performed.
- Secure a technical data warranty for a long enough period to help ensure that another manufacturer can produce the product.
- Have a Government laboratory or independent contractor "test" parts of the data package to validate the capability for manufacture by another source.
- If feasible, secure an option to purchase the data, to be exercised within a stated period.

Cost analyses and risk analyses are two methods applicable to data rights strategy. As the DAR suggests, the cost of acquiring the data should be smaller than the savings such purchase will yield. The savings may be realized through the competitive process but, as in many of the strategies for increasing competition (e.g., leader-follower, licensing), the original contractor is normally well down the learning curve when a new source becomes viable. A gross estimate—such as competition reduces lot costs by X percent—is generally not possible without a careful survey of industry capability and investigation of the potential difficulties of a start-up operation, including the requirement for investing in special production tooling and processes.

The risk analysis addresses the risks associated with having only a single source and the risks associated with the technology transfer. If the equipment is critical for military operations and there are no alternatives, purchase of the data rights may be justified even if the potential cost-to-savings ratio is unfavorable. For this type of assessment, the expected lifetime of the equipment is analyzed (often equipment is used longer than originally anticipated), together with the viability and integrity of the initial contractor and subcontractors.

With respect to the technology-transfer risks, engineering and production personnel should assess the feasibility of manufacturing transfer within a reasonable time and at reasonable cost. These and other functional personnel should participate in developing the data specifications to minimize risks.

In Reference 7 a model for evaluating second-source alternatives was presented. Fourteen variables that have a bearing on developing and implementing a second-source strategy were identified (see Section 5.3 for a discussion of these variables). Table 5-4 is an adaptation of the model for evaluating a technical data package strategy—in the pre-production and post-production phases. The latter is for the case in which a program is already in production and consideration is being given to creating a second source through a data rights purchase. A "+" entry indicates strong applicability for the variable shown. A "0" indicates neutral applicability, while a "-" entry indicates a weak applicability. Situations in which purchasing a technical data package is particularly inappropriate are indicated by "N/A."

5.5.8 Functional Interfaces

The prime interfaces of data rights within the scope of this section are in production strategy and the business/financial strategy. The system design obviously influences the data package. Test and evaluation can be employed to assess the suitability of the data for second-source manufacture. The facilities strategy interface is related to the production aspects. A management information system is needed to maintain configuration control and data package updates.

Functional Interfaces:
Data Rights

Design	X
Test and Evaluation	X
Production	Primary
Deployment	
Personnel/Organization	
Schedule	
Business/Financial	Primary
Management Information	X
Facilities	X

TABLE 5-4

EVALUATION CHECK LIST FOR DATA RIGHTS

Variables	Pre-Production	Post-Production
Quantity		
High	+	+
Medium	+	0
Low	0	N/A
Duration		
Long	+	+
Medium	+	0
Short	0	N/A
Learning Curve		
Steep	-	0
Flat	+	+
Technical Complexity		
High	N/A	N/A
Medium	-	-
Low	+	+
State of the Art		
Yes	N/A	N/A
No	+	+
Spin-Off Application		
Yes	0	-
No	+	0
Degree of Private R&D		
High	N/A	N/A
Low	0	0

Key:

+ = Strong applicability
0 = Neutral applicability
- = Weak applicability
N/A = Not applicable

(continued)

TABLE 5-4 (continued)		
Variables	Pre-Production	Post-Production
Tooling Costs		
High	-	-
Low	+	+
Government Tool Transfer Cost		
High	0	0
Low	+	+
Contractor Capacity		
Excess	-	-
Deficient	+	+
Maintenance Requirement		
Significant	0	0
Minimal	+	+
Production Lead Time		
Long	-	-
Short	+	+
Degree of Subcontracting		
Heavy	-	-
Light	+	+
Contractual Complexity		
Complex	-	-
Simple	+	+

Key:

+ = Strong applicability
0 = Neutral applicability
- = Weak applicability

5.5.9 Time Line

The decision to secure production data rights is made prior to FSD. Thus early consideration is required to make that decision and to formulate applicable sections of the RFP. Opportunities will also occur during reprocurement as indicated by the dotted lines in the time line.

Time Line: Data Rights

Milestones

	0	1	2	3
Decision			●	●....
Implementation			——	....

5.5.10 Recent Experience

A recent Acquisition Strategy Survey indicated that about five of every six programs implemented some data rights strategy. Experience was 70 percent positive, 20 percent neutral, and 10 percent negative. Cost and resource requirements were the reasons for negative outcomes.

5.5.11 Research and Sources of Information

1. Beck, A.W., "Is It Legal to Use That Data?" *Program Manager*, DSMC, Vol. X, No. 3, May-June 1981.
2. Fargher, J.S.W. Jr., "International Transfer of Intellectual Property for Defense Material," *Defense Systems Management Review*, Vol. 3, No. 3, Summer 1980.
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5.5.12 Applicable Directives, Regulations, and Pamphlets

a. Acquisition of Technical Data and Computer Software (Sec. 9, Part 5), Rights in Computer Software Acquired under Contract (Sec. 9, Part 6), DAR, Section 9, July 1, 1976.
b. DAR 9-701.3, Patent Rights Under Government Contracts. Procedures.
c. DAR 9-202, Acquisition of Rights in Technical Data.
d. DAR 7-104.9, Rights in Data and Computer Software.
e. Department of the Air Force, AF Regulation 800-14, Vol. II, Acquisition and Support for Computer Resources in Systems, September 12, 1975.

5.6 DESIGN-TO-COST

5.6.1 Definition

DODD 4245.3 of April 6, 1983 defines design-to-cost (DTC) as:

> "An acquisition management technique to achieve defense system designs that meet stated cost requirements. Cost is addressed on a continuing basis as part of a system's development and production process. The technique embodies early establishment of realistic but rigorous cost objectives, goals, and thresholds and a determined effort to achieve them."

The DTC goal initially used is the average unit flyaway (or rollaway, sailaway) cost associated with an end item of military hardware. As the ability to translate operations and support cost elements into "design to" requirements improves, DTC goals and thresholds are related to total life-cycle-cost (LCC) considerations.

5.6.2 Problem Addressed

The DTC process is directed toward helping to modernize DoD weapon systems in sufficient quantities to provide a suitable deterrence and fighting capability at an affordable cost. Before the DTC process was established, weapon system costs had

been rising at a rate much faster than inflation. The most common reasons cited for cost growth (in addition to quantity changes) in past programs were:

- Initial poor estimates of costs
- Cost escalation due to inflation
- Cost growth due to changes
- Overhead escalation due to reduced business/ production

DTC is one of the tools available to establish cost thresholds and to evaluate the impact of performance trades to meet DTC objectives, goals, and thresholds. To be useful, DTC efforts need to be sufficiently flexible to accommodate program changes and provide an audit trail of the impact of these changes on DTC parameters.

5.6.3 Alternative Forms

The DTC concept includes several categories of cost control standards:

- Design to Unit Production Cost (DTUPC). This was the original DTC application, and conceptually the easiest to understand and apply. By Milestone II, the Program Manager usually has established a DTUPC estimate stated in terms of a selected base year's dollars, production rate and total buy, and production start date.
- Operating and Support (O&S) DTC Parameters. Approved values for selected O&S elements expressed either in dollars or by other measurable factors, such as number of maintenance personnel, spares, fuel, and other resource consumption, reliability, and maintainability.
- Design to Life-Cycle Cost (DTLCC). This theoretical concept could enable the Program Manager to make desirable trades among all program and system activities.

5.6.4 Advantages

The foremost advantage is that DTC is a proven acquisition management tool for obtaining lower unit costs so that enough systems and equipments can be procured to meet the threat and can be operated efficiently.

Additional advantages are:

- DTC defines a measurable design parameter that might be considered as important as performance, leading to the identification and establishment of cost elements as management goals for accomplishing the desired balance between cost, schedule, and performance. DTC parameters are approved measurable values for selected cost elements established during system development as design considerations and management objectives for subsequent life-cycle phases. A DTC parameter may be an objective, goal, or threshold. Values will be expressed in constant dollars, resources required, or other measurable factors that influence cost.
- DTC provides a basis for communication and coordination of effort between Government and industry participants. It also promotes program stability by dampening fluctuations in user requirements; a Program Manager can defend a DTC balanced program against the unfunded "take it out of your hide" type of change. The cost goals can serve as a "contract" between the Program Manager and the OSD for major programs or the service for smaller projects.

5.6.5 Disadvantages

DTC has certain disadvantages:

- It forces the Program Manager to commit to a DTC goal well before final agreement on configuration and operational requirements. Hence, the need to "sell" the program may drive DTC goals down to unrealistic levels.
- Since there are no practical ways to validate LCC estimates, the Program Manager (as well as the contractor if incentives are being used) may choose to trade down readiness, suitability, or sustainability to meet unit production cost goals. Hence, O&S parameters are sometimes better expressed in quantifiable factors other than then-year dollars.
- Additional people, time, and effort are required to plan and execute the DTC program. The existence of the DTC program could tend to inhibit tailoring and innovation.

5.6.6 Application Criteria

Originally, DTC was applied only to major programs. DODD 4245.3 has expanded the scope of the process by stating that the management and procurement principles are equally valuable for, and should be applied to, the acquisition of systems below the DSARC threshold, subsystems, and components. DTC goals shall be established and controlled within DoD components for these systems in a similar manner. Approval authority for cost goals and changes to the goals will be maintained at a management level above the program or subsystem manager.

The applicability of DTC has also been broadening in the scope of costs considered. Originally, because

of inadequate visibility of costs in the O&S areas, DTC was applied only to production costs – specifically, to the unit production cost of an article of hardware. However, the ultimate objective is to ensure that the system developed will have the lowest life-cycle cost consistent with schedule and performance requirements.

The DTC goals must accurately reflect the critical cost factors of the program, and they must be measurable, manageable, and useful to Government and contractor program managers. To be useful, the cost goals must be stated in constant dollars for some specified year to account for inflation factors. Deflation indices that convert then-year to baseline-year dollars should be specified when the goal is established. In addition, it is necessary to identify production quantities and rates and the delivery schedule. Since very few weapon system programs proceed through development and production unchanged, it is important to identify procedures and factors (such as learning curves) that can measure the progress toward achieving DTC goals if modifications are made in the production quantity rate or schedule.

The DTC goals discussed above are best suited for programs with relatively large production quantities. In other programs, goals different from flyaway or unit production cost can be used. For programs with low production quantities or proportionally high development costs, total acquisition cost would be a better DTC goal. Programs with high O&S costs in proportion to the acquisition amount would call for DTC controls on the total life-cycle cost.

DODD 4245.3 recognizes two exemptions to application of DTC which the Secretary of Defense can authorize:

- Applicability. Those very few programs which, for reasons of National security, have performance or schedule goals that take priority over cost goals.
- Execution. Use of other than flyaway and O&S costs for DTC parameters (e.g., reliability, maintainability).

5.6.7 Analysis and Development

DTC is based on five straightforward principles:

1. Early DTC goal establishment. About two-thirds of a system's life-cycle costs are virtually determined before DSARC I. An initial cost goal must be established in the conceptual phase, and cost-performance trade-offs must be made in the initial design phase to meet that goal. The initial DTC goal should be related to how much DoD originally paid for the capability the new system is to replace, how many of the new systems are needed, and what proportion of the DoD budget can realistically be expected to be available for this new system, given the fiscal "facts of life."
2. Use of new technology to lower cost rather than to increase performance. This requires a change on the part of engineers who for years have been encouraged to rank performance over cost.
3. Design flexibility. Both the RFP and the contract must build in an atmosphere that permits and encourages cost-performance trades to be offered and accepted.
4. Cost estimating and tracking. The DTC goal should be allocated down the work breakdown structure and tracked regularly for both prime contractor and subcontractor efforts. The DTC goal should be related to quantity from Unit 1 on up; setting a DTC goal for Unit 1 imposes strict discipline on the designer and permits an early indication of compliance.
5. Contractual incentives. Contractual innovations are needed to give the contractor an incentive to build a reliable, low-cost product. Reliability Improvement Warranties and award fees are two such schemes.

Although some of these factors lie outside the domain or control of the design engineer, they directly affect the final unit production cost. Thus it is apparent that engineering management must be fully cognizant of the DTC objectives and must work to minimize design changes that could result in exceeding the cost threshold. Finally, effective DTC execution mandates that the Program Manager take appropriate action to maintain awareness of corporate overheads and other burden factors. DTC development consists of two broad steps – setting goals, and estimating and controlling costs – as described in the following subsections.

5.6.7.1 Setting Goals

The recommended DTC goal is generally a difficult but achievable objective that challenges designers, engineers, and Program Managers to their best efforts. The goal must be realistic. A goal that is too high in relation to the required performance wastes money, and an excessively low goal sets the stage for cost growth, buy-ins, or unacceptable systems.

The recommended goal should be included in the SCP or DCP and submitted for review. Rationale to support the goal – e.g., production quantity and rate, cost/quantity relationship (learning curve), applicable escalation indices, and O&S cost-related

factors—should be presented. The recommended goal will be reviewed by the approval authority (Secretary of Defense for DSARC-level programs), and the official DTC goal will be established.

It is important to note that although a firm DTC goal may not be feasible at Milestone I, some initial estimate of the resources available for the program should be made to guide the cost aspects of effort leading to Milestone II. Those initial estimates can then be shaped and changed as the concept evolves into an approach, and then into a design for entry into the Demonstration and Validation phase. These early considerations of cost will at least put the Program Manager in a better position to recommend DTC goals and thresholds not later than at entry into FSD. Early consideration of cost goals and the development of confidence in those goals as the program progresses are vital elements in obtaining the maximum benefit from DTC.

5.6.7.2 Estimating and Controlling Costs

The key part of the DTC concept is the ability to estimate costs throughout the system life cycle. Cost analysis techniques, coupled with affordability considerations, are used to establish the initial DTC goal. Different types of cost analysis (parametric or technical) may be used either to establish or to update the cost estimate. Experience from previous DTC applications shows the importance of obtaining an independent cost estimate at significant review and decision points in the program for comparison and validation of the program's estimate.

The emphasis that DTC has placed on early cost estimating and analysis has resulted in marked improvement in these activities at all levels. For example, to aid in cost analysis, some manufacturers have provided their designers with guideline data on the cost of materials, assemblies, and fabrication for a wide range of processes. These data are generally proprietary and are not readily available. However, the military services have cost data acquired from past procurements that can be useful in cost analyses.

5.6.8 Functional Interfaces

DTC is one of the key management activities throughout the design portion of a program. The focal point for the total DTC effort is the military Program Manager, who must do the following:

- Assist in establishing DTC goals
- Develop DTC application plans
- Ensure that DTC principles are incorporated into RFPs, source selection, and contracting, and that cost is continually considered in trade-off decisions
- Perform cost/performance/schedule trade-offs within the established goals
- Allocate cost goals to program elements
- Assure that cost estimates are properly tracked against the established goals
- Develop a summary work breakdown structure to provide management visibility
- Conduct periodic program reviews

It is apparent from this comprehensive list of activities that the Program Manager should consider DTC as an integrating function that ties together many of the functional strategies.

Functional Interfaces:
Design-to-Cost

Design	Primary
Test and Evaluation	X
Production	X
Deployment	X
Personnel/Organization	
Schedule	X
Business/Financial	X
Management Information	X
Facilities	X

5.6.9 Time Line

It is important that the DTC goal be established as early as possible in the development cycle, because early design decisions will have the major impact on cost. Thus a firm DTC goal should be recommended as soon as the system is defined to the extent that the cost associated with achieving minimum acceptable performance can be estimated with confidence. DODD 4245.3 states that the DTC goal shall be established before Milestone I or at the earliest practical date thereafter, but in no case later than entry into Full Scale Development. Table 5-5 highlights the DTC activities by program phase.

Time Line: Design-to-Cost

Milestones

	0	1	2	3
Decision		●····●		
Implementation		———		

5.6.10 Recent Experience

Experience with DTC has ranged from some of its earliest applications—the often publicized successes

TABLE 5-5

TIME LINE FOR DTC IMPLEMENTATION

Milestone	Program Phase	Program Activities	DTC Implications
O	Concept Exploration	- Mission Requirement - Concepts Studies - System Concept Paper	- Performance Requirements - Recommended LCC Factors - Recommended Average Unit Flyaway Cost
I	Demonstration and Validation	- System and Production Feasibility - Validation Studies - Decision Coordinating Paper (DCP)	- Cost, Schedule, and Performance Risks - DTC Program Requirements - Approved DTC Goals
II	Full Scale Development	- Specification Allocation - System Test - Cost Analysis - Detailed Design - Updated DCP	- Performance Requirements - Average Unit Flyaway Cost - Production Contract Structure and Incentives
III	Production and Deployment	- Acquisition of Systems - Initial Support for Systems - Plans for Modification or Product Improvement	- Cost Goal Verification - Updated Goals Due to Modification Baseline - Compilation of System Cost History

in the AN/ARN-XXX TACAN and A-10 programs—to several reported in a 1982 study conducted for DSMC:

- F-16, in which design trade studies were used as the basis for the payment of the award fee
- AV-8B, in which the objective is based on the prime contractor direct labor hours, and this objective is subject to adjustment
- MX missile, with a DTC incentive clause in the development contracts of the four missile stages, the guidance and control system, and the re-entry system
- AN/TPO-36 Firefinder radar, with award fee used as a contract incentive

Attention should be given to the impressions of current Program Managers and their staffs concerning experience with DTC. Responses to acquisition strategy surveys were analyzed and summarized as part of the data base for preparing this guide. Of all the strategy issues and alternatives considered (e.g., competition, incentives), the one reflecting the highest negative experience (about 20 percent) was design-to-cost. The reasons cited included (1) lack of understanding of how O&S DTC was to be accomplished, (2) requirement to establish DTUPC goals and thresholds before system design converged, and (3) difficulty in accommodating engineering changes into DTC reporting.

Searching through the literature, one can discover a sobering number of major programs that started out with expressed pride in their DTC efforts and yet in succeeding years gained, perhaps unfairly, notoriety for significant cost overruns. The best that can be learned from the past is that DTC can work, although it is not easy. Factors that appear to have an impact on success are:

- Complexity. A component development presents fewer challenges than a complete system.
- Technology Advance. A component or subsystem for which data and experience are available is easier to estimate.
- Production Run. High-volume programs (aircraft, for example) are more successful than those with small runs (e.g., major ships).
- Contractor. Contractors with experience in the commercial marketplace appear to be more receptive and innovative.

5.6.11 Research and Sources of Information

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6. Emmelhain, Margaret A., "Innovative Contractual Approches to Controlling Life Cycle Costs," *Defense Management Journal*, No. 19, Second Quarter 1983, pp. 36–42.
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12. "Selecting Design-to-Cost Goals Requires Realism and Flexibility," *Defense Management Journal*, September 1974.

5.6.12 Applicable Directives, Regulations, and Pamphlets

a. DODD 4245.3, Design to Cost, 4 April 1983.

b. Joint Design-to-Cost Guide, 15 October 1977 (DARCOM P700-6, NAVMAT P-5242, AFLC/AFSCP 800-19).

c. AFR 800-11, Life Cycle Cost, 27 January 1984. (Note: Implementing guidance for U.S. Army and U.S. Navy is to be developed)

d. *System Engineering Management Guide*, Defense Systems Management College, 1983, Chapter 17.

5.7 INCENTIVES

5.7.1 Definition

Incentives represent a contractual strategy to reward the contractor for meeting or exceeding defined goals and, in some cases, to penalize the contractor for failure to meet goals. Incentives can be applied to any system or acquisition characteristic, including cost, schedule, performance, producibility, reliability, maintainability, and quality, and they can be applied at any phase of the program.

An incentive contract is used to motivate the contractor to meet or exceed target levels when there is uncertainty about the outcome and the contractor has some control of the outcome.

5.7.2 Problem Addressed

Contractors have a number of goals, including profit, perpetuation, growth, and prestige. It is generally accepted that most defense contractors are basically averse to risk and operate from the premise of a satisfactory profit at acceptable risk rather than maximum profit at a high risk. For many military acquisitions, the risks are high. Incentive contracts offer a means of motivating contractors to achieve more than minimal program objectives without excessive risk.

An example is an award-fee contract, in which the contractor is paid a "bonus" in addition to the basic fee if a stipulated higher level of performance is met. If the contractor expends no effort to meet that level, it incurs no risk and wins no extra fee. On the other hand, the contractor may expend resources to achieve the higher performance level if the return on investment appears to be good. This incentive approach does not force the contractor to undertake a high-risk task but provides motivation to 'o so if the potential return is acceptable. The "return" may include more than immediate contract profit. For example, if the incentive area involves implementation of new technology, long-range benefits may result from a successful endeavor, e.g., technical spillover to commercial applications.

5.7.3 Alternative Forms

Most incentive contracts involve cost factors, as identified by the contract type, e.g., cost plus incentive fee (CPIF) and fixed price plus incentive fee (FPIF). However, an increasing number of incentive arrangements are based on characteristics other than cost, particularly award fees and various forms of warranties and guarantees.*

There are two broad categories of contracts: cost-reimbursable and fixed-price. For cost-reimbursable contracts, the contractor provides best efforts to meet the contract terms and conditions and the Government pays all of the allowable costs that meet the test of reasonableness. Risks to the contractor are minimal. For fixed price, the contractor must provide the required product or service at a predetermined price, regardless of the actual cost. Contractor risks are much more severe. Cost-plus-fixed-fee (CPFF) and the firm-fixed-price (FFP) contracts represent the boundaries of the contract-type spectrum with respect to the contractor risk. Within these boundaries, there are a number of possible variations. The following are three of the more common contract forms with incentive features:

- Cost Plus Incentive Fee (CPIF). Used in advanced engineering, systems development, and first production contracts when uncertainties of performance preclude a fixed-price contract but are not so great as to require a cost-plus-fixed-fee contract. A target cost and a target fee are established, together with minimum and maximum fees. Cost overruns and underruns are shared in accordance with a negotiated formula until the minimum or maximum fee is reached. There is no ceiling price.
- Fixed Price Incentive Fee (FPIF). Used in much the same way as CPIF, but where there is less uncertainty in establishing a total ceiling price. The FPIF has the same characteristics as CPIF except that a ceiling price is established and there are no minimum or maximum fees.
- Cost Plus Award Fee (CPAF). A cost-reimbursement contract with a fixed (base) fee and an award-fee pool. Some or all of the award-fee pool is paid to the contractor as a reward for achieving performance in designated areas above minimum acceptable levels. Management and performance are typical areas.** The underlying theory of the award fee is to have the contractor earn extra profit rather than negotiate it.

Within each of these three major types there are numerous variations, such as varying share ratios and

*Incentives in the form of warranties and guarantees are treated in Section 5.15.

**The design-to-cost (DTC) concept generally uses an award-fee approach. DTC is addressed separately in Section 5.6.

successive targets. In addition, there are multiple-incentive contracts, which attempt to balance performance, schedule, and cost objectives and risks.

5.7.4 Advantages

Incentive contracts provide a means of adjusting risks to accommodate cost and technical uncertainties while providing motivation for above-minimum effort by the contractor. Through the incentive contracting process, which includes Government/industry dialogue, more realistic objectives can emerge, leading to more realistic contractual commitments—a key element in any contract.

When properly structured and implemented, an incentive contract can accomplish the following:

- Provide greater realism in negotiating
- Increase cost-consciousness
- Encourage Government/contractor cooperation
- Recognize limitations of contractor management and control options
- Account for motivational variability
- Provide the contractor flexibility in meeting target values

5.7.5 Disadvantages

Despite the inherent attractiveness of incentive contracts, which have been used in various forms for decades, there is still a wide range of opinions on their value. Many studies have failed to find significant relationships between contract type and expected results (e.g., number and size of cost overruns [see Reference 5]). Among the disadvantages are the following:

- The cost and complexity of administration are increased.
- It is difficult to establish realistic targets.
- There is a tendency to create incentives for too many elements, leading to complex, poorly understood relationships.
- Contract complications arise from Government-directed changes.
- The profit motive, the essence of incentive contracting, may not be the prime motive of the contractor.

5.7.6 Application Criteria

Incentive contracts may be applicable when a firm-fixed-price contract is not appropriate—i.e., definite functional requirements cannot be specified, confidence in achieving a required level is not high, or fair and reasonable prices cannot be established at the outset. To plan for an incentive contract, the Program Manager should ensure that it is possible (1) to establish reasonable and attainable targets that can be clearly communicated to prospective contractors, and (2) to include appropriate incentive arrangements that motivate contractor efforts to exceed target levels and discourage waste and inefficiency.

Generally, fixed-price incentives are preferred to cost incentives. The latter are more appropriate when the uncertainties of contract performance do not permit costs to be estimated accurately enough to permit use of a fixed-price contract. This is generally the case for the early development phases. Cost-type incentive contracts impose the following requirements:*

- The contractor's accounting system is adequate for determining contract costs.
- Appropriate Government surveillance can be provided to give reasonable assurance that efficient cost-control methods are used.
- A determination and findings process has confirmed that a cost-type contract is likely to be less costly than any other type or that it is impractical to use any other type.

Table 5-6 presents general guidelines on the applicability of various contract types.

5.7.7 Analysis and Development

Determining the need for an incentive contract, and the type to be used, depends on an accurate assessment of program risks. When risk is minimal and uncertainties are not extreme, a fixed-price contract may be appropriate, with or without incentives. Cost-type contracts are employed in greater-risk situations, typically in the research and development phases, when cost estimates are highly imprecise or technical and other uncertainties do not permit accurate assessment of future performance. From an acquisition strategy perspective, the Program Manager must act as follows:

1. Determine if an incentive contract form is a suitable alternative for each phase.
2. Acquire resources and data to investigate incentive potential further.
3. Select applicable incentive forms for each phase for selected cost/performance/schedule parameters.
4. Establish basic guidelines for entering into final contract negotiations.

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*Federal Acquisition Regulation, Section 16.301-3, 1 April 1984.

TABLE 5-6

APPLICABILITY OF VARIOUS CONTRACT TYPES

Contract Type	Application Criteria
Cost Plus Fixed Fee (CPFF)	"Level of effort" is required or high technical and cost uncertainty exists.
Cost Plus Award Fee (CPAF)	Conditions for use of CPFF exist, but improved performance is desired and objective measurement is difficult.
Cost Plus Incentive Fee (CPIF)	A given level of performance is desired and confidence in achieving it is reasonably good, but identifiable uncertainties exist.
Firm Fixed Price (FFP)	Performance has been demonstrated, and technical and cost uncertainty is low.

These steps are briefly considered in the following subsections.

5.7.7.1 Step 1: Determine the Suitability of an Incentive Contract

The suitability of an incentive contract can be determined by assessing:

- The uncertainty or risks associated with cost/performance/schedule outcomes
- The ability of the contractor to control the outcome, at least partially
- The desire of the contractor to exercise available control

As stated earlier, incentive contracts are appropriate when the outcome is uncertain because of inherent risks or the inability to define requirements. If uncertainty is high, there must also be an element of contractor control; otherwise there is no basis for the incentive provision. In addition, the contractor must be willing to exercise control. Generally, cost incentives are directed toward the profit motive. Yet, as discussed earlier, there are many other corporate motivations that are not necessarily consistent with near-term profits.

5.7.7.2 Step 2: Acquire Resources and Data

Step 1 will provide a very early assessment. If there appears to be an incentive potential, then further evaluation is necessary. The participation of a contracts specialist is mandatory, and representation from applicable functional offices should be used to explore the risks further. A business strategist should be brought in to evaluate the contractor perspectives and perform industry liaison. For high risk areas, a strategy for acquiring relevant data to assess and reduce risks should be considered. For example, a Government laboratory might be tasked to perform technical assessments.

5.7.7.3 Step 3: Select Applicable Incentive Forms

The incentive "committee" will be tasked to recommend specific contract forms and approaches. For ease of exposition, we consider only the cost parameter at this point. A concept called Range of Incentive Effectiveness (RIE) has evolved. Minimum, target, and maximum cost outcomes are estimated. In the strategy development phase, the RIE will be preliminary. It will be based on judgment to a great extent, supplemented with analyses using available

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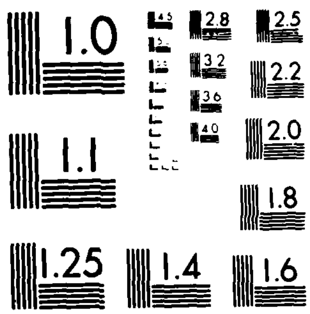

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data and cost-estimation tools. The variation in costs, as indicated by the deviation of minimum and maximum values from the target costs, provides a basis for selecting the form of incentive. One early incentive guideline suggests the following:

If the minimum and maximum cost values deviate from the target costs

- By less than 10 percent, use a fixed-price contract.
- From 10 percent to 15 percent, use a fixed-price incentive contract.
- From 15 percent to 25 percent, use a cost-plus-incentive contract.
- Over 25 percent, use a CPFF contract.

These percentages must be used carefully. Their simplistic appeal suggests a degree of precision not generally present in the complex process of selecting the contract type. In the early strategic development phases, the cost estimates will be tenuous, and the percentage guidelines should be used to only suggest the form that the incentive may take.

One procedure for acquiring additional data to develop strategic guidelines is to send out draft RFPs to prospective contractors for review and comment.

5.7.7.4 Step 4: Establish Basic Guidelines

The first three steps provide the initial approach to identifying appropriate forms of incentive contracts. The incentive strategy then requires providing the overall plan for final contracting, which includes:

- Identification of incentive areas
- Specification of viable alternative contract types
- Identification of approaches for acquiring additional data
- Guidelines for narrowing the choice of alternatives
- Guidelines for finalizing contract form and negotiating strategy

5.7.7.5 An Assessment Approach

To aid in the assessment of incentive contract forms, a contract-type "spreadsheet" has been suggested (Reference 9) as illustrated in Figure 5-4.

The Government's prioritized objectives are shown in column 1, and the risks associated with attaining them (high, medium, low) are placed in column 2. Similar entries are made for the contractor in columns 3 and 4. In columns 5, 6, etc., various contract types are considered. For each contract type, the effect on the Government and contractor objectives is then assessed. For example, if one Government objective is cost control and one contractor objective is profit, a CPIF contract increases the Government risk but reduces the contractor risk (see Figure 5-5). This might be an acceptable solution if cost control is a low Government priority while profit is a high contractor priority. The strategy to seek is one in which risks are equitably shared on the basis of the priorities of each party.

5.7.8 Functional Interfaces

The primary functional interface of incentive contracting is the business/financial strategy. Technical design aspects are also of concern and an appropriate management information system is required to monitor contractor performance. Test and evaluation, production, deployment, and schedule strategies can be also involved, depending on the nature and extent of the incentive provisions.

Functional Interfaces: Incentives

Design	X
Test and Evaluation	X
Production	X
Deployment	X
Personnel/Organization	
Schedule	X
Business/Financial	Primary
Management Information	X
Facilities	

5.7.9 Time Line

The use of contract incentives should be considered as early as possible, and potential contractors should be notified of the possibility. A key to an effective cost incentive is to have a realistic target cost, which may require considerable time and study. If contractors are aware that performance or schedule incentives will be used, they can plan accordingly during the early development stages when they may have more flexibility to take advantage of the future incentive provisions.

Time Line: Incentives

Milestones

	0	1	2	3
Decision		•	•	•
Implementation		———	———	———

Options	Government		Contractor		Contract Forms		
	Prioritized Objectives (1)	Risk Level (2)	Prioritized Objectives (3)	Risk Level (4)	(5)	(6)	(7)
1							
2							
3							

FIGURE 5-4

GOVERNMENT/CONTRACTOR OPTION EVALUATION FORM

Options	Government		Contractor		Contract Forms		
	Prioritized Objectives (1)	Risk Level (2)	Prioritized Objectives (3)	Risk Level (4)	CPIF (5)	(6)	(7)
1			Profit	High	Reduces risk		
2							
3	Cost Control	Low			Increases risk		

FIGURE 5-5

EXAMPLE OF GOVERNMENT/CONTRACTOR OPTION EVALUATION FORM

5.7.10 Recent Experience

A number of studies of contracts awarded in the 1960s failed to confirm some of the basic tenets of incentive contracting. For example, several studies that analyzed a large number of incentive contracts could not find a statistically significant relationship between cost outcome and the contractor share of deviation of total costs from target cost. Theory indicates that the higher the contractor share, the lower the overrun. It has been suggested that the 1960s were characterized by unrealistically high target costs (Reference 5). That would tend to prevent useful analysis of share ratios. The same reference suggests that low target costs were characteristic of the 1970s, perhaps as a result of an effort to "sell" programs to Congress as DoD budgets came under increasing scrutiny. However, many studies have confirmed that incentive contracts make sense and can work if fully understood and properly implemented. In the survey of current Program Managers, 65 percent indicated positive experience with incentives, 21 percent were neutral, and 14 percent indicated a negative experience. A high official of a major aerospace corporation has been quoted as saying, "Incentives are

not magic, they are damned hard work. They are hard to structure, hard to manage . . . but incentives are among the best management tools we have."

The Navy F/A-18 aircraft illustrates application of the award-fee approach to controlling operation and support costs (Reference 6). A total of $39 million was reserved as the award-fee pool, split as follows:

- $15 million DTUPC, life-cycle cost and program management
- $12 million reliability
- $12 million maintainability

The maintainability aspects are reviewed here.

The F/A-18 will replace the F-4 and A-7 aircraft in the Navy fighter and attack fleets. In 1982 maintenance man-hours per flight hour were 59 for the F-4J and 45 for the A-7E. The comparable requirement for the F/A-18 was 18 hours, 11 of which were design-related. This 11-hour value became the F/A-18 requirement.

To determine the award-fee payment, specific targets were established for maintenance-action frequency and man-hour requirements. Measurements were to be made at 1200, 2500, and 9000 flight hours, targeted early enough to influence design.

Table 5-7 summarizes the R&M incentive program. It is seen that the contractor met most requirements and earned $11.26 million of the $12 million award-fee pool. For this program, the award-fee pool represented a significant amount of money. Fleet evaluations of operational aircraft show that the mature goal of 18 maintenance man-hours per flight hour is being approached.

5.7.11 Research and Sources of Information

1. DeMong, R.F., "Award Fee Contract Provisions as a Program Management Tool," *Proceedings of the 1983 Federal Acquisitions Research Symposium*, 1983, pp. 168-174.
2. Gordon, H.J., "The Role of the Contract in Systems Acquisition," *Defense Systems Management Review*, Vol. 3, No. 1, Winter 1980.

TABLE 5-7

F-18 RELIABILITY AND MAINTAINABILITY INCENTIVE PROGRAM*

Program Point (Flight Hours)	Criteria	Maintainability Values		Award Amount ($ Millions)	
		Target	Achieved	Potential	Received
1200	Unscheduled Maintenance Man-Hours/Flight Hour	8.0	7.72	1.5	1.5
2500	Unscheduled Maintenance Man-Hours/Flight Hour	5.0	3.62	2.5	2.5
2500	Total Direct Maintenance Man-Hours/Flight Hour	16.0	6.36	1.5	1.5
2500	Mean Flight Hours Between Maintenance Action	1.5	1.16	1.5	1.14
9000	Total Direct Maintenance Man-Hours/Flight Hour	12.1	6.48	2.5	2.5
9000	Mean Flight Hours Between Maintenance Actions	1.48	1.31	2.5	2.12
			Total	12.0	11.26

*From Reference 6.

3. Hardy, C.A., "The F-16: A Successful Effort to Contain Logistics Support Costs," *Defense Management Journal*, Vol. 20, No. 1, 1984.
4. Hunt, R.G., "Concept of Federal Procurement: The Award Fee Approach," *Defense Management Journal*, Vol. 18, No. 2, 1982.
5. Kennedy, J.J., *Incentive Contracts*, Air Force Business Research Office, November 1, 1980.
6. Kilpatrick, C.L., "Taking the Sting Out of Hornet Support Costs," *Defense Management Journal*, First Quarter 1984, Vol. 20, No. 1.
7. Meneely, Cdr. F.T., USN, "Determining the Appropriate Contract Type," *Concepts*, Vol. 5, No. 3, 1982.
8. Murphy, R.L., "Cost Risk and Contract Type: A Normative Model," *Proceedings of the 1983 Federal Acquisitions Research Symposium*, 1983, pp. 193-197.
9. Williams, R.F., "Designing the Equitable Risk Contract," *Proceedings of the 1983 Federal Acquisitions Research Symposium*, 1983, pp. 49-53.

5.7.12 Applicable Directives, Regulations, and Pamphlets

a. *Incentive Contracting Guide*, (ANSA, NHB 5105.34), (Army FM 38-34), (Navy NAVMAT P-4283), (Air Force 70-1-5), (DSA, DSAH 7800.1), DoD/NASA, October 1969.

5.8 MAKE-OR-BUY

5.8.1 Definition

Make-or-buy, in its precise procurement meaning, refers to the program that identifies (and subsequently obtains) the major components, assemblies, and subassemblies to be manufactured by the contractor's own facilities and those which will be obtained elsewhere by subcontract. "Make" items can be produced by the contractor or its affiliate, subsidiary, or division; "buy" items come from subcontractors or suppliers.

5.8.2 Problem Addressed

The make-or-buy decision recognizes that few, if any, contractors can or want to fabricate all of the many components needed for a sophisticated, complex major weapon system in the time required, within cost limits, and at the required quality level. "Buy" decisions result in the inclusion of subcontractors and suppliers in the program. Subcontractor management can confront the Program Manager with a new set of problems. Other areas that the make-or-buy process can affect are associated with social legislation goals such as the use of small, women-owned, or minority-owned business on Federal contracts. In general, make-or-buy seeks to accomplish the following:

- Assure the lowest program costs commensurate with necessary system requirements
- Restrain unfair prime or major contractor growth into areas where a sufficient mobilization base and cost information exists
- Effectively use Government-owned facilities
- Aid implementation of National social policies

5.8.3 Alternative Forms

Although make-or-buy considerations normally focus on the narrower procurement-related definition, Program Managers should be aware of other types of make-or-buy alternatives that have a distinct effect on the selection and execution of acquisition strategies. These alternatives are described in the following subsections.

5.8.3.1 Preferable Methods for Satisfying Material Needs

Early in every program, the Program Manager must conduct an analysis that permits selecting the best method to satisfy mission requirements:

- New development program. The choice to "make" a new system is usually the most costly and involves the longest time for equipment deployment.
- Modification of existing, other services, or foreign items. This alternative combines "make" and "buy."
- Product improvement. This alternative exploits the growth potential inherent in already developed systems, thereby also mixing some "make" with "buy."
- Purchase of existing military (or commercial) domestic or foreign items. This "buy" alternative can provide low-cost, quick response to some requirements.

5.8.3.2 Use of Contractor-Furnished Equipment Versus Government-Furnished Equipment

The effects of this issue on program planning, implementation, and success are profound. In this alternative, "make" refers to using GFE; "buy" refers to

choosing CFE. Significant pressures exist in the following areas:

- Cost. GFE can lower life-cycle costs, for three reasons:
  - Development should be complete.
  - There are production advantages due to larger purchases.
  - Standardization and commonality advantages should contribute to support cost savings.
- Risk. The use of GFE can increase program technical risk (if GFE is not compatible or does not meet performance guarantees); schedule risk (if GFE is late or defective); and cost risk (if GFE shortcomings or late deliveries result in program delays or changes). Some participants in the DD-963 Destroyer Program attribute the program's success to the conscious strategy of minimizing the use of GFE; other programs (e.g., F-5E International Fighter) realized the full benefits of extensive use of GFE.

5.8.3.3 In-House Versus Contractor Performance of Technical and Support Services

Throughout the program's life, each Program Manager is responsible for preparing a virtually endless number of plans, studies, analyses, evaluations, and reports. The make-or-buy choice concerns how and where the work will be done—in-house (i.e., "make") within the Government, including staff agencies, field locations, laboratories, and other services; or by outside contract (i.e., "buy") through a hardware-related, support, or Federal Contract Research Center (FCRC) contractual relationship. The factors involved in such a decision include:

- PMO organization. A fully staffed PMO (so-called "Super Project Office") will be more likely to keep all significant work in-house than will a matrix-dependent PMO.
- Nature of the work. Some, almost one-of-a-kind tasks (e.g., Environmental Impact Statement) might be performed faster, better, and with less need for management attention through use of a specialized technical support company. On the other hand, a highly qualified PMO might want to retain a task normally assigned to the contractor; for example, the B-1 Program Office functions as the system integrator instead of having a prime contractor fulfill that responsibility.
- Potential conflict of organizational interest. Sensitive areas that involve procurement plans or source-selection activities most properly belong under strict Government control.
- Cost to perform. A Program Manager may be able to find a laboratory or field activity that is available for technical support at nominal cost or perhaps no cost. Technical assessments and risk-reduction efforts during the early phases of the program are good candidates for support of this type.

5.8.4 Advantages*

Consistent and comprehensive application of make-or-buy provisions yields worthwhile advantages to the Government:

- Better cost estimating and control
- Increased visibility of contractor's management competence
- Greater achievement of social legislation goals
- More effective structure for Government-contractor dialogue
- Earlier indication of areas of technical or schedule risk

5.8.5 Disadvantages

Disadvantages associated with the application of make-or-buy include the following:

- Contractor control of the program decreases when the Government forces a decision to "buy," especially from a small, minority-owned, or women-owned business. The level of competence of such firms may be such that the management effort needed to maintain effective control is much greater than the proportion of work actually involved.
- The time required to initiate, plan, obtain approval for, and then conduct a make-or-buy program can affect the Program Manager's ability to award or change contracts.

5.8.6 Application Criteria

A make-or-buy program is generally required in procurements where the item, system, or work is complex and price competition is inadequate. The Government should consider the following factors in evaluating the contractor's make-or-buy program:

- Can the contractor justify production of items that it does not normally make?
- What effect will proposed use of facilities have on overhead?

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*Note: From this point, the discussion refers to make-or-buy in its procurement meaning.

- Has adequate consideration been given to small, women-owned, or minority-owned businesses?
- What is the contractor's prior make-or-buy history?
- Does the contractor have adequate technical, financial, and personnel capabilities as well as requisite experience to justify his recommendations?
- Can the proposed subcontracted work be adequately managed to protect the Government's interest?

5.8.7 Analysis and Development

Government offices must analyze the proposed make-or-buy programs on the basis of cost, cost realism, ease of management, and overall benefit to the Government. Requirements for a make-or-buy program should be requested in solicitation documentation in accordance with Data Item Description (DID) DI-P-3460/P-113-1 (or equivalent); this DID enables the Government to evaluate and approve in a manner that is in full compliance with the requirements of the April 1984, FAR 15.707 and DoD FAR Supplement.

The basic steps in the make-or-buy process are illustrated in Figure 5-6.

Make-or-buy reviews are generally held at the contractor facility by groups representing the functional skills of production control, quality control, purchasing, and engineering; the group will be headed by a highly placed manager or staff member. The Government will evaluate the proposed make-or-buy program during the first stages of contract negotiation; also, the program must be approved by the contracting officer prior to contract award.

From the contractor's viewpoint, the following are the reasons for "make" or "buy":

Make

- Develop capability, people, process
- Use idle capacity
- Maintain work force for future
- Retain ability for close supervision
- Facilitate process and change control
- Minimize transportation problems
- Retain confidential designs or process secrets
- Reduce dependence on outside sources of supply

Buy

- Technical know-how lacking
- Investment in equipment, tools, or equipment not justifiable
- Volume required too large or too small
- Risky market demands better handled by specialty supplier
- Better quality available from outside supplier
- Basis provided for checking in-house costs
- Patents or trade secrets involved
- Reciprocity possible

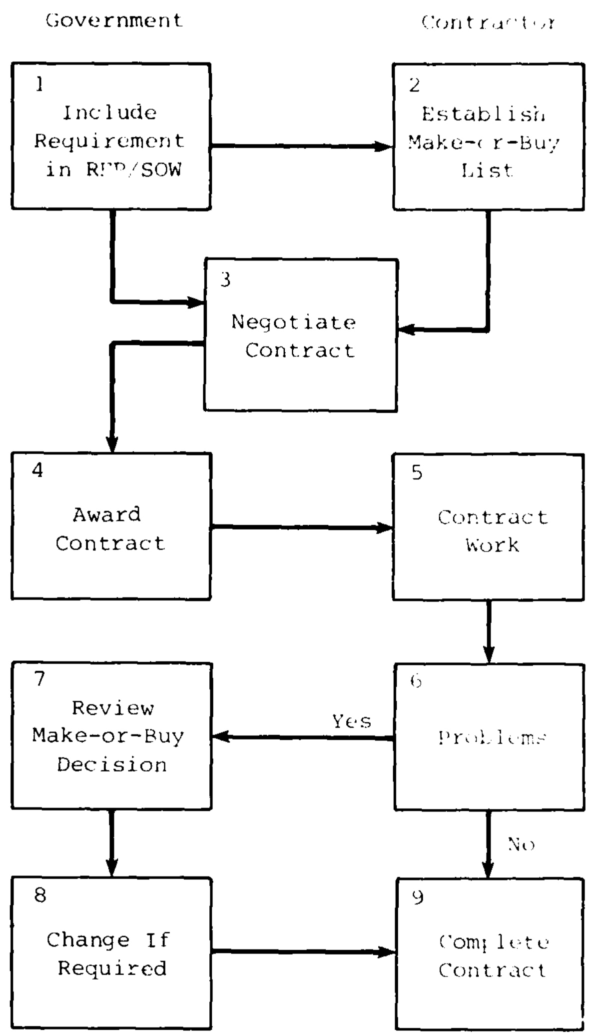

FIGURE 5-6

MAKE-OR-BUY PROCESS

5.8.8 Functional Interfaces

Make-or-buy can be a central concern in the design and production phases. It is primarily a contracting issue, with strong influences from the schedule and facility areas.

Functional Interfaces:
Make-or-Buy

Design	X
Test and Evaluation	X
Production	X
Deployment	
Personnel/Organization	
Schedule	X
Business/Financial	Primary
Management Information	
Facilities	X

5.8.9 Time Line

Make-or-buy is associated principally with production contracts. Research and development programs are exempt from make-or-buy provisions unless the Program Manager anticipates that follow-on quantities of the product will be procured. The Government must ensure that any production-related solicitation documentation requires a full description of the contractor's make-or-buy program, including purchasing system and proposed subcontractor(s). Any detailed schedule should incorporate the activities listed earlier in this section. The following time line indicates that make-or-buy is predominantly a development or production activity:

Time Line: Make-or-Buy

	Milestones			
	0	1	2	3
Decision		•	•	
Implementation		....	....	—

5.8.10 Recent Experience

Every major program is required to consider the make-or-buy provisions. Approximately 70 percent of current programs surveyed indicated positive experience with make-or-buy. There were no indicated negative experiences. Programs can be either directly or indirectly affected by make-or-buy decisions:

- Directly: The Air Force's C-130, which had been significantly subcontracted for years, was almost totally brought back to the Lockheed facilities when that company discontinued the manufacture of commercial L-1011 aircraft.
- Indirectly: The A-10 and T-46 aircraft program overhead costs were negatively affected when business conditions compelled Boeing to pull back B-747 fabrication work that had been subcontracted to Fairchild Industries.

5.8.11 Research and Sources of Information

Program Managers should work directly with contracting officers and procurement specialists to ensure understanding of and compliance with FAR make-or-buy requirements. Also of interest are:

1. *Government Prime Contracts and Subcontracts Service*, Volume III, Section K, Chapter 2, "Make or Buy," Covina, California, Procurement Associates, Inc., 1976.
2. Beverly, John G., Frank J. Bonello, James Deschback, and William I. Davisson, "The Make or Buy Decision – It's Nature and Impact," *Proceedings of the 1983 Federal Acquisition Research Symposium*, 7-9 December 1983.
3. Stimson, Dr. Richard A. and Marilyn S. Barnett, "Buying Commercial: What Works and What Doesn't Work," *Eighth Annual DOD/FAI Acquisition Research Symposium*, 4-6 May 1979.

5.8.12 Applicable Directives, Regulations, and Pamphlets

Make-or-buy, as a legally authorized and required contractual mechanism, is described in:

a. FAR 15.707, Incorporating Make-or-Buy Programs in Contracts, April 1984.
b. DOD FAR Supplement, Subject 15.7, Make-or-Buy Programs, April 1984.
c. Data Item DI-P-3460/P-113-1, Make or Buy Programs, September 1971.
d. "Make-or-Buy Programs," *Government Contracts Reporter*, 21,500, September 1982, Chicago.
e. AFR 800-22, CFE and GFE Selection Process, 30 August 1976.

5.9 MULTIYEAR PROCUREMENT

5.9.1 Definition

Multiyear procurement (MYP) is a method of acquiring more than one year's but not more than five years' requirements under one contract. Each program year is budgeted and funded annually, but the commitment is for at least several years. The Defense Acquisition Regulation (DAR) defines multiyear contracting as "... a method of acquiring for DoD planned requirements for up to a five-year period ... without having total funds available at time of award."

5.9.2 Problem Addressed

Single-year contracting for major systems has been the usual method of acquisition for many years. The quantities are authorized and the funds are appropriated annually. Contractors are not willing to commit to expenditures for long-lead items, economical-order quantities, or equipment investment when they are not sure of future business. The DoD, industry, and GAO have all stated that this method of acquisition is inefficient.

5.9.3 Alternative Forms

MYP can be more efficient and less costly than single-year procurement by allowing or encouraging the following:

- Quantity purchases for out-year deliverables
  - Materials
  - Components
  - Subsystems
  - Subassemblies
  - Assemblies
- Efficient labor utilization over the life of the contract
- Contractor capital investment (e.g., purchase of tooling or facilities to achieve cost efficiencies)

5.9.4 Advantages

The benefits of MYP are to reduce procurement costs and provide incentives for industry investment. MYP has been favorably viewed by Congress, industry, and the military. The Military Departments and industry have cited favorable experience to date.

- Cost savings are realized by the use of MYP versus single-year procurements depending on the depth to which MYP is applied, i.e., materials, components, subassemblies, or assemblies.
- Business is stimulated because more economical purchases from vendors and subcontractors are permitted; an incentive to invest in new equipment is provided; and there is orderly buildup, stability, and scaling back of personnel.
- A potential for meeting surge requirements develops in the second and subsequent years of the contract by virtue of the assured existence of the suppliers, subcontractors, and vendors.

5.9.5 Disadvantages

The benefits appear to be substantial for MYP, but it is not a sure method for reducing costs in all systems. There are limitations and problems:

- There are high penalty costs in the case of program reduction or contract cancellation.
- Highly variable conditions cause significant risk for both the Government and industry. High inflation, unstable markets, changing requirements, and changing technology create genuine concerns for industry.
- Risk increases in direct proportion to the depth to which MYP is applied to a particular system, i.e., materials purchase, component purchase, LRUs, major subassemblies, major assemblies.
- Congress believes that it loses some control over defense funds allocated for MYP. It cannot make annual changes without incurring penalties.
- Contractors have expressed concern over inadequate economic price adjustments for contracts extending over long periods. They believe that the Government should provide some coverage of risk clearly beyond the contractor's control, such as changes to Federal and state tax laws and changes to Federal and state environmental control laws and regulations. They also want coverage regarding late or deficient GFE, embargoes, and strikes.
- Where a single contractor or a contractor team is locked into a long-term contractual arrangement, MYP might restrict technology development on the part of nonparticipating contractors, because of the lack of capital or incentive to remain technically competitive.

5.9.6 Application Criteria

The reasons for selecting MYP are to reduce costs, schedule activities more productively, and provide incentives for industry investment. If the program is not amenable to MYP after it is started, the option to terminate the MYP could entail substantial cancellation liability. Congress has set the advanced procurement cancellation ceiling at $100 million. Guidelines for MYP compatibility were promulgated

by the Deputy Secretary of Defense in a Policy Memorandum (1 May 1981).

The process of deciding to use or not to use a multiyear procurement (MYP) for production programs as well as how best to tailor and structure MYP requires management judgment. The following criteria have been prepared as guidelines for decision-makers. The criteria are to be considered in a comparative benefit/risk analysis format where criterion 1 below, represents the benefit factor, and criteria 2 through 6 represent risk factors (see References 3 and b).

1. **Benefit to the Government**. A multiyear procurement should yield substantial cost avoidance or other benefits when compared to conventional annual contracting methods. MYP proposals with greater risk to the Government should demonstrate increased cost avoidance or other benefits over those with lower risk. Savings can be defined as significant either in terms of absolute dollars or percentage of total cost.
2. **Stability of Requirement**. The minimum need (e.g., inventory or acquisition objective) for the production item or service is expected to remain unchanged or vary only slightly during the contemplated contract period in terms of production rate, fiscal year phasing, and total quantities.
3. **Stability of Funding**. There should be a reasonable expectation that the program is likely to be funded at the required level throughout the contract period.
4. **Stable Configuration**. The item should be technically mature, have completed RDT&E (including development testing or equivalent) with relatively few changes in item design anticipated and underlying technology should be stable. This does not mean that changes will not occur but that the estimated cost of such changes is not anticipated to drive total costs beyond the proposed funding profile.
5. **Degree of Cost Confidence**. There should be a reasonable assurance that cost estimates for both contract costs and anticipated cost avoidance are realistic. Estimates should be based on prior cost history for the same or similar items or proved cost estimating techniques.
6. **Degree of Confidence in Contractor Capability**. There should be confidence that the potential contractor(s) can perform adequately, both in terms of Government furnished items (material, data, etc.) and their firm's capabilities. Potential contractors need not necessarily have previously produced the item.

5.9.7 Analysis and Development

MYP requires additional outlays of money in the early years and results in cost savings in later years. A financial analysis using contractor learning experience, constant dollars, net present value, and discounted cash flow is necessary. It is important to understand the MYP terminology. The following are commonly used terms and their generally accepted definitions (Reference 3):

"**Single-Year Contracting** (annual buys) refers to the method of acquiring one or more years" requirements one year at a time (even though deliverables may extend over several years) through the use of separate contracts or through separately priced options on a single-year contract.

"**Cancellation** is unique to multiyear contracts. A cancellation is the unilateral right of the Government to discontinue contract performance for subsequent fiscal years' requirements. Cancellation is effective only upon the failure of the Government to fund successive fiscal year requirements under the contract, or failure to put money on the contract by the time called for by the contract. It is not the same as termination.

"**Cancellation Ceiling** is the maximum amount that the Government would pay the contractor for recurring and nonrecurring costs (and a reasonable profit thereon) in the event of contract cancellation.

"**Nonrecurring Costs**, related to multiyear contracts, are production costs that are generally incurred on a one-time basis and amortized over the entire MYP production quantity.

"**Recurring Costs**, related to multiyear contracts, are production costs such as labor and material that vary with the quantity being produced.

"**Termination**, contrasted with cancellation, can be effected at any time during the life of the contract and can be for the total or a partial quantity. (Cancellation would be for all subsequent fiscal years' quantities.)

"**Termination Liability** is the maximum cost the Government would incur if a contract were terminated.

"**Advance Buy Procurement** is an exception to the full funding policy. It is the acquisition and financing of components, both recurring and nonrecurring, in a fiscal year in advance of that in which the related end item is to be acquired.

"**Block Buy** is a method of acquiring more than one year's requirement under a single contract. A total quantity is authorized and contracted for in the first contract year. A block buy is a type of MYP and is funded to the termination liability."

The basic analytical method is to compare single-year procurements with multiyear procurements through discounted cash flow and net present value techniques. (Present value analysis is discussed in DODI 7041.3.) The RFP should be structured so that all potential savings due to multiyear procurement are identified in prime and subcontractor proposals. As one example, the methodology for the Navy C-2A aircraft reprocurement MYP analysis consisted of development of two parallel estimates. One estimate was for the normal procurement method (single year) and was fully auditable. The other estimate was for multiyear purchases. Figure 5-7 shows the process (Reference 2).

5.9.8 Functional Interfaces

Multiyear procurement is of primary concern in a business/financial strategy. It interfaces with production, schedule, management information, and facilities strategies with respect to long-lead purchases, quantities produced versus delivered, cost information available on single-year procurements, and investment in equipment or buildings.

Functional Interfaces:
Multiyear Procurement

Design	
Test and Evaluation	
Production	X
Deployment	
Personnel/Organization	
Schedule	X
Business/Financial	Primary
Management Information	X
Facilities	X

5.9.9 Time Line

A firm decision to use MYP does not have to be made until the production and deployment phase when the design has stabilized, production has begun, and the program appears to be firm for at least the next several years. However, MYP must be considered early in FSD to perform analyses in order to include this option as part of the Milestone III decision. Another possibility is the reorder of an existing equipment. Implementation would follow Congressional approval and would probably begin two years after initiation of the comparison study.

Time Line:
Multiyear Procurement

Milestones	0	1	2	3
Decision				•
Implementation				.... ——

5.9.10 Recent Experience

All the services have multiyear procurements in progress. Table 5-8 lists examples. The Reprocured C-2A Program is the Navy's first major multiyear aircraft acquisition, entailing the purchase of 480 units over five years. The Navy is expecting a 12 percent saving in the program and savings of 20 to 30 percent in specific component areas on the basis of subcontractor and prime contractor estimates. After the first two years, the Government is now estimating better-than-anticipated savings, while industry, through an aggressive approach, has noted stabilized employment, benefits to modernization programs, and increased efficiency in existing operations. Similarly, the Army is reporting a 10 percent saving in the multiyear procurement of the T-700 engine, 8 percent for the Blackhawk Helicopter, and an 11 percent saving for the Multiple Launch Rocket System. The Air Force is expecting to save more than 10 percent on the F-101 engine for the B-1B, and has achieved a 10 percent saving on GAU-8 ammunition.

Congress does not consider MYP an "automatic" initiative to reduce costs. Nine of DoD's 16 fiscal year 1984 candidates were rejected as not meeting appropriate criteria. During the past three years since MYP was initiated, about half the programs proposed by the services have been approved by the Congress. In general, Congress apparently is not willing to forgo annual budget control unless potential MYP savings of about 10 percent appear to be reasonably achievable.

5.9.11 Research and Sources of Information

1. Dews, E. and M.D. Rich, *Multiyear Contracting for the Production of Defense Systems: A Primer*, The Rand Corporation, N-1804-AF, January 1982.

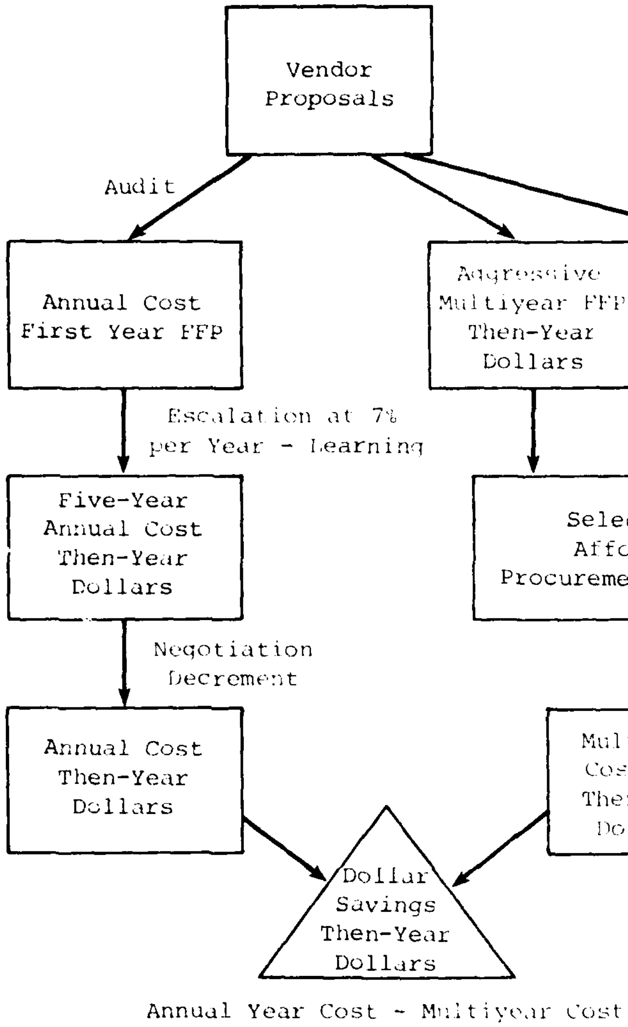

FIGURE 5-7

MULTIYEAR SAVINGS METHODOLOGY (REFERENCE 2)

2. Fromer, Harry S. and John L. Sweeney, "Multi-Year Procurement, 'A Team Approach'," *Proceedings of the 1983 Federal Acquisition Research Symposium*, pp. 188-192.
3. Lafors, Lt. Col. Kary R., USAF, "Selecting Programs for Multiyear Procurement," *Concepts*, Vol. 5, No. 2, Spring 1982, pp. 54-65.
4. Raney, Capt. Terry, USAF, "Using Multiyear Procurement to Promote Defense Industry Investment," *Program Manager*, January-February 1983, pp. 14-19.
5. Rasch, Ronald H. and Maj. Jonathan L. Breary, USAF, "Multiyear Procurement: A Current Perspective," *Concepts*, Vol. 5, No. 2, Spring 1982.
6. Sansone, Capt. J. et al., "Major Issues Challenge Effective Management of the Acquisition Process," *Naval Supply Corps Newsletter*, Vol. 43, No. 12, December 1980, pp. 15-24.
7. Singer, Dr. G. and Col. G.D. Brabson, USAF, "Enhanced Multiyear Procurement for Improving Systems Acquisition," *Concepts*, Vol. 5, No. 3, Summer 1982, pp. 112-129.

TABLE 5-8

RECENT MULTIYEAR PROCUREMENTS*

USA	USN/USMC	USAF
MLRS (11%)	C-2A (12%)	F-101 Engine (12%)
M1 Abrams Tank	CG-47/AEGIS	GAU-8 Ammunition (10%)
QUICK FIX IIB	Ohio Class Submarines	B-1B
UH-60 Blackhawk (8%)	Torpedo Mk 46 (10%)	F-16 C/D
T-700 Engine (10%)	A-6E	KC-10A
TOW-2	CH-53	GPS
Bradley Fighting Vehicle		DSP
		TRC-170

*Multiyear procurements may be at subsystem level. All percentages reflect estimated savings.

5.9.12 Applicable Directives, Regulations, and Pamphlets

a. Carlucci, Frank C., Deputy Secretary of Defense Memorandum, "Improving the Acquisition Process," 30 April 1981.
b. Carlucci, Frank C., Deputy Secretary of Defense Memorandum, "Policy Memorandum on Multiyear Procurement," 1 May 1981.
c. DODI 7041.3, Economic Analysis and Program Evaluation of Resource Management, October 1972.
d. DAR 1-322, Multiyear Contracting (DAC 76-20, 1979).
e. DAR 3-815, Capital Investment Incentives (DAC 76-16, 1979).

5.10 PHASED ACQUISITION

5.10.1 Definition

Phased acquisition in its most common application utilizes a low-rate initial production (LRIP) in transitioning from Full Scale Development to Production and Deployment. The premise is that production articles can benefit from development design changes and test results and from initial low-rate production and early operating experience, such that it is worthwhile to delay high-rate production and full deployment of the system for some period. The system life-cycle cost is expected to be lower because of corrections of deficiencies early in production and deployment and the reduced need to correct production articles on the production line and in the field. Recently LRIP has also been used to allow sufficient time for a second production source to produce an "educational" lot, while holding the primary source from moving too far down the learning curve and obtaining a large competitive advantage.

Phased-acquisition alternatives might also include consideration of warm production base, cold production base, and production breaks, but these are usually used to protect production sources once a system has been produced and deployed. For the consideration of Acquisition Strategy, this section will focus on LRIP.

5.10.2 Problem Addressed

Phased acquisition addresses the problem of an immature design's reaching production and being fielded before it is ready. The transition from development to production and deployment is the most difficult activity to manage. Concurrent activities are proceeding in testing, correction of design deficiencies, and initial production and deployment of the system. Phased acquisition is intended to ensure that the system is close to a final production article before full production is implemented. It addresses the problem of overcoming early deficiencies discovered in design and testing and in the field, and correcting those deficiencies prior to full production and field deployment, thereby causing the least perturbation to the overall procurement and deployment plan.

5.10.3 Alternative Forms

Phased acquisition is most beneficial for a technologically advanced, highly complex weapon system for which time is needed to mature the design and provide test information and early production and field deployment experience, and where initial low-rate production is acceptable to program objectives. It provides design, test, producibility, and operational information while holding down the cost of production line and field retrofit. It can also be used to initiate a competition using a second production source. In formulating an acquisition strategy, the selection and timing of an initial production rate, whether sole-source or competitive, and the time allowed to transition to full rate must be appropriately integrated with the design, test, and production activities.

There is heavy institutional pressure from industry for producing systems at high production rates. These provide the large sales and profits for industry, and the argument is that high rate is more efficient and thus less expensive for the Government. This is true if the system is not technologically advanced and complex, as is usually the case in most commercial products.

However, even advanced-technology commercial products tend toward high rate early in an attempt to capture the market. The results are sometimes catastrophic. Such market pressure is not present in military applications, but the National need may be very urgent and thus a careful decision by Government program management is required. Low-rate initial production in the military allows more time to make use of test results and early field data to correct deficiencies prior to full production. A failure reporting, analysis, and corrective action system is critical to achieving the feedback required to identify and correct deficiencies.

Phased acquisition requires the following:

- Clear management direction that this is the approach that will be pursued
- A tendency toward an austere initial development
- Intense early performance testing and operations to obtain data to mature the design
- Feedback and analysis of early test and operational data to mature the design prior to full production
- Realism concerning the technology assessment and schedule flexibility

5.10.4 Advantages

Phased acquisition provides an opportunity to obtain more test data and early production and field operating data with which to correct deficiencies prior to high-rate production. It provides early visibility and timely information to reveal and correct performance and support problems; at the same time it reduces the number of units requiring retrofit in production and in the field. It also provides some flexibility in obtaining more information about uncertainties in performance and cost, while providing better information to enable more informed decisions. When high rate is approved, more operationally ready articles are delivered to the field and life-cycle cost is lower. Modifications to fielded articles are more expensive than modifications made prior to production; configuration management is more difficult when more deficiencies are being corrected; and inventories require the stocking of a greater variety of part types and more parts if more deficiencies are being corrected. Therefore, even though the full operational capability schedule may appear to be longer, the date at which a specific level of capability is achieved might actually be earlier.

5.10.5 Disadvantages

Phased acquisition requires a longer program schedule and thus delays full operational deployment. Earlier production units will be more costly because of lower production rate. During periods of high inflation, time delays could seriously perturb the funding stability of the program and increase costs. Longer exposure to annual incremental funding could jeopardize the continuation of the program, for various reasons (e.g., technical, political) as it moves through the acquisition process. Less advanced technologies (or a P^3I approach) might be encouraged

in order to avoid this option and its longer schedule. Another concern of the commercial sector is that slower production encourages more performance-oriented engineering change proposals (e.g., gold-plating or cosmetic changes).

5.10.6 Application Criteria

Phased acquisition might be appropriately applied to technologically advanced, highly complex weapon systems for which early visibility and timely information concerning design, test, production, and operational problems are essential to achieving program objectives. An early initial operational capability could be achieved within the context of a low-rate initial production, thus permitting the collection of test data, production experience, and field data to correct deficiencies prior to high-rate production. Full operational capability would take longer.

5.10.7 Analysis and Development

A cost-benefit analysis should be performed to compare expected operational capability improvements and cost savings during the life cycle of the weapon system procured at high rate versus low initial rate. The comparison would require taking into account the smaller number of deficiencies corrected in the field and the higher costs of delaying production in the early years for phased procurement. Experience with other programs of similar technological advance would be a necessary part of the analysis. The technical comparison would relate expected sortie rates of aircraft, for instance, at earlier and later times. Figure 5-8 is an example of a full-rate production program and an LRIP program. The differences in deliveries and time are shown for high-rate production (N_1, T_1) and for LRIP (N_2, T_2). The fewer deliveries ($N_1 - N_2$) and longer time ($T_2 - T_1$) of LRIP provide the opportunity to correct early deficiencies at lower cost and still obtain an effectiveness level at the same time or earlier. A risk management system and failure reporting and feedback from testing are important elements in employing this strategy.

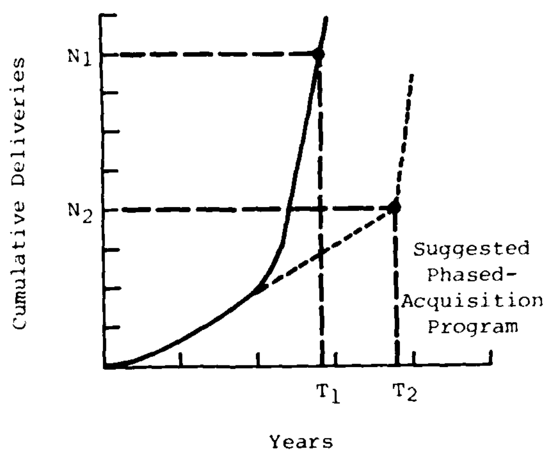

FIGURE 5-8

PHASED ACQUISITION

5.10.8 Functional Interfaces

The primary functional interface is with production; another very important functional interface is business/financial. Other functional areas that are also affected include design, testing, deployment, schedule, management information, and facilities.

Functional Interfaces:
Phased Acquisition

Design	X
Test and Evaluation	X
Production	Primary
Deployment	X
Personnel/Organization	
Schedule	X
Business/Financial	X
Management Information	X
Facilities	X

5.10.9 Time Line

The decision to select low-rate initial production must be made prior to Full Scale Development and indeed prior to request for proposals for Full Scale Development, since the acquisition strategy to be used in development and deployment must be identified so that the contractors can price the appropriate strategy.

Time Line: Phased Acquisition

Milestones

	0	1	2	3
Decision		•		
Implementation			———	———

5.10.10 Recent Experience

Of current programs surveyed, 70 percent indicated positive experience with phased acquisition. There was no negative experience. A program that is now utilizing low-rate initial production, because it is a technologically advanced system and it intends to make production competitive, is the Torpedo Mk 50 Program for the U.S. Navy. Previous analyses of selected Air Force programs (C-5, F-111, A-7D) have

indicated that cost savings and performance enhancements would have been realized if a phased-acquisition strategy had been used. The difficulty is in assessing the value of having the system earlier, with less capability and at higher cost, rather than later, when it is more capable and less costly (if funding perturbations have not affected the program).

An analysis of the A-7D aircraft, for example, indicated that the sortie-rate capability would have been doubled and the life-cycle cost reduced if a phased-acquisition strategy had been employed (and numerous avionics deficiencies had been corrected prior to high-rate production).

5.10.11 Research and Sources of Information

1. Lee, A., *A Strategy to Improve the Early Production Phase in Air Force Acquisition Programs*, Doctoral Dissertation, The Rand Graduate Institute, May 1981.

5.10.12 Applicable Directives, Regulations, and Pamphlets

a. DODD 4245.6, Defense Production Management, January 1984.
b. DODD 4245.7, Transition from Development to Production, January 1984.

5.11 PRE-PLANNED PRODUCT IMPROVEMENT

5.11.1 Definition

Pre-Planned Product Improvement (P^3I) makes it possible to develop and field a new weapon system while improvements to that system are being planned for phased integration. P^3I has been defined as a systematic and orderly acquisition strategy beginning at the system's concept phase to facilitate evolutionary, cost-effective upgrading of a system throughout the life cycle to enhance readiness, availability, and capability.

5.11.2 Problem Addressed

Since the early 1950s, the acquisition philosophy for weapon systems has been predominantly one of pushing the state of the art. Once a threat has been validated, the technology for countering that threat is developed, thereby enabling a weapon system to be developed and deployed. If a technology or threat change occurs during the development of the weapon system, one of two actions can be taken in response to the change: (1) redesign the weapon system to incorporate the change, or (2) continue the development to deployment as originally designed and plan to modify the system later in the field.

Both of these approaches can be costly to implement, and complete success in meeting a new threat may not be achieved. On the other hand, starting the development with a system requirement designed to meet probable future threats may induce unacceptable risks if the required technology is not available. P^3I affords a means of meeting the current threat and making plans for meeting probable future threats or improving the system as technology becomes available, without having to develop a new system.

P^3I also addresses a related problem—that of trying to incorporate a number of available but new technologies all at once. The technological problems that can result from trying to do too much too soon can lead to serious management and resource difficulties as unexpected interface, reliability, support, and other deficiencies emerge.

A graphical depiction of the P^3I concept over the system life cycle is presented in Figure 5-9. DoD's commitment to P^3I as an acquisition alternative is evidenced by the fact that it is one of the initiatives included in the *1981 Acquisition Improvement Program*. In July 1981 OSD promulgated a specific implementation plan directing the services to consider P^3I in the acquisition strategy for all new programs.

5.11.3 Alternative Forms

Product improvement (PI) is sometimes confused with P^3I, as is planned product improvement (PPI). Product improvement is applied when a system is in the field and changes or corrections must be incorporated to overcome problems. Planned product improvement represents a change to the system that is generally anticipated but that the basic system was not originally designed to accommodate. Examples include the upgradings of the Polaris, Minuteman, and Pershing missile weapon systems.

P^3I differs from PI and PPI in that it is planned evolutionary growth. The need for eventual modification is recognized during the early development stages, and the acquisition strategy is designed to include provisions for ensuring that these modifications can be effectively introduced. Specific design strategy applicable to P^3I include modular design,

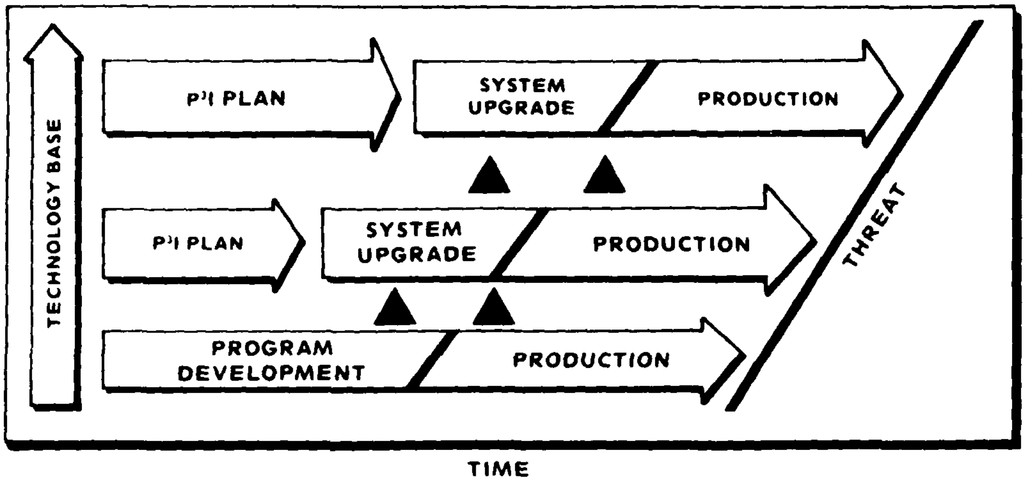

FIGURE 5-9

P^3I ACQUISITION CONCEPT (REFERENCE 6)

a carefully architectured interface system, and inclusion of reserves for space, weight, power, and cooling. The system development process must include strategy and plans for communicating system growth requirements and for identifying new technological opportunities.

5.11.4 Advantages

The following advantages result from an effective implementation of P^3I:

- Responsiveness to threat changes and future technology development
- Earlier IOC date for baseline system
- Reduced development risks
- Potential for subsystem competition
- Enhanced operational capability for "final" system
- Stimulation for laboratory and IR&D research
- Increased effective operational life

5.11.5 Disadvantages

Possible disadvantages of using the P^3I concept include:

- Increased nonrecurring cost during initial development
- Increased technical requirements in such areas as space, weight, power, and cooling
- Increased complexity in configuration management
- Vulnerability to "gold plating" criticism and funding cuts
- Compounding of the system management problem because of parallel developments
- Interference with the orderly development and implementation of effective support plans and procedures

5.11.6 Application Criteria

The following application criteria have been identified to help ensure that a P^3I approach will be effectively implemented.

- There is a long-term military need for the system. P^3I can shorten the development time for the basic system, but implementation of the evolutionary changes will normally lengthen the total development period.
- There is a high risk that current technology will not meet an expected future threat but a low risk that forthcoming technology cannot meet such a threat.
- There is a near-term need to build a system with current technology capabilities.
- The service, DoD, and Congress demonstrate a commitment to acquiring the system under the P^3I concept, including acceptance of initially higher costs.
- The system can be designed to incorporate planned technology development. Perhaps the most critical criterion is the capability for modularizing the system to minimize integration and retrofit problems.
- Analyses are performed that show – on the basis of threat, development risk, and total life-cycle cost – that P^3I is the most effective means of meeting overall long-term program objectives.

5.11.7 Analysis and Development

P^3I must be started during the conceptual phase and integrated into the acquisition strategy at its inception. Two essential ingredients are:

- The evaluation of the current and future threat growth
- The evaluation of current and future technological capability

Thus the first step in effectively evaluating P^3I potential is to determine what capabilities are required now, what will be required in the future, and what technical resources are or will be available to meet them. These types of analyses lead to a set of system requirements, which can include an orderly, time-phased introduction of enhanced system capability.

Cost, risk, and utility are three major elements in analyzing P^3I potential. P^3I entails an initial cost increment that can be substantial; yet total costs over the system life span can be reduced. Attempting to incorporate new, unproven technology immediately is very risky. Utility provides one analysis measure. Can a baseline system using available technology satisfy current needs while the new technology is incorporated through the P^3I approach? Clearly, threat projections and a study of mission needs are important analysis methods for making risk assessments.

Basic alternatives to be considered in analyzing P^3I-related strategy alternatives are as follows:

- Baseline system – improvement incorporated as needed
- Baseline system for the present; new system developed thereafter
- P^3I – baseline system designed for planned stepwise improvements
- Advanced system incorporating advanced technology

The strategy-decision-matrix approach described in Chapter Four is one method of developing a scoring measure for these alternatives or their variants, using capability to meet mission/threat objectives as the major scoring factor. Coupling these scores with estimates of the total costs of each alternative over a selected life span provides a basis for decision.

The following steps are suggested for implementing P^3I:

1. Perform applicable threat and technology assessments to identify the need for and potential effectiveness of P^3I implementation.
2. Develop a set of system requirements documents that identify the evolutionary technical developments to be incorporated.
3. Include P^3I as a specific element of the acquisition strategy, and budget applicable time, funds, and contractor support.
4. Develop a plan for translating system growth requirements into an initial design strategy to facilitate P^3I implementation.
5. In the test and evaluation strategy and associated functional plans, include approaches for ensuring that the P^3I approach remains viable through the development and deployment phases. This may involve "reserving" production systems for use as P^3I test beds.
6. In the acquisition strategy, include approaches for ensuring that logistics supportability will be maintained at a satisfactory level for the basic system during the P^3I upgrade period and after all P^3I improvements are implemented. It may be necessary, for example, to develop a P^3I approach for the system support equipment.
7. As development proceeds, develop strategy and plans as required for developing, contracting, scheduling, budgeting, and implementing P^3I modifications. If P^3I is a separately budgeted item, resource requirements must be identified in the PPBS cycle and placed in the appropriate documents, such as the POM, FYDP, and EPA.

5.11.8 Functional Interfaces

The primary functional interface for P^3I is the design strategy. Test and evaluation, production, and deployment strategies will also be affected. For example, the baseline design should be evaluated for its capability to accept the planned modifications; the production strategy should ensure that appropriate materials and tooling will be available for modification; and the deployment strategy should include the approach for phasing in the updates. Resource strategies affected by P^3I include the schedule, business/financial, and management information strategies. The latter should include a well disciplined plan for configuration management.

Functional Interface:
Pre-Planned Product Improvement

Design	Primary
Test and Evaluation	X
Production	X
Deployment	X
Personnel/Organization	
Schedule	X
Business/Financial	X
Management Information	X
Facilities	

5.11.9 Time Line

The decision to use P³I should be made as early in the program as possible—some time during the early part of the Concept Exploration phase but not later than Milestone I. Implementation will begin shortly thereafter, since the design strategy is the primary interface.

Time Line: Pre-Planned Product Improvement

	Milestones 0	1	2	3
Decision		•		
Implementation		——	——	——

5.11.10 Recent Experience

A number of military programs have employed P³I approaches. Table 5-9 summarizes those programs. It should be noted that for some of the programs listed, the activity might represent more a planned improvement than a pre-planned approach. The approaches and experience of several programs are summarized in the following subsections.

5.11.10.1 Air-Launched Cruise Missile

In anticipation of a future need for increased range, structural strengths were increased beyond initial design requirements, and supports and intended configurations were designed to accommodate the potential increase in propellant load. To accommodate a variety of wing (elevon) designs for a variety of missions, fastening was achieved with accessible bolts rather than permanent bonding. Not only were field modification requirements reduced, but manufacturing assembly was also simplified.

5.11.10.2 F-16

The capabilities of the F-16 aircraft are continually evolving since initial introduction. Planned improvements include the Advanced Medium Range Air-to-Air Missile (AMRAAM), the Airborne Self-Protection Jammer (ASPJ), the Global Positioning System (GPS), a 30mm gun pod, and other performance and weapon capabilities. A comprehensive plan was adopted to accommodate the introduction of such capabilities, including:

- Wing structure and wiring provisions for beyond-visual-range air-to-air missiles
- Engine inlet structure and wiring provisions for various electro-optical and target-acquisition pod systems
- Cockpit structure to accommodate various forthcoming capabilities
- Increased-capacity environmental control system
- Increased tail size for meeting maneuverability requirements when pods or other armaments are added

One example cited as justification for such initial expenses is that to add AMRAAM without preplanning would involve removing the wings from the

TABLE 5-9

SURVEYED PROGRAMS INDICATING USE OF P^3I

USA	USN/USMC	USAF	Joint
TOW	Deep Submergence Vehicle	ALCM	JVX
MLRS	EA-6B	MILSTAR Terminal	AMRAAM
Patriot	Torpedo Mk 50	B-1B	JTACMS
ASH/AHIP	FFG	JTIDS	
QUICK FIX II (SEMA)	Harpoon	T-46	
	Ohio Class Submarines	F-16	
		C-17	

aircraft; completely tearing them down to replace spars, slats, and flaps; and then reskinning and reinstalling. Costs for such an effort would far exceed the costs of planning for the upgrade by having an appropriate wing structure design initially.

5.11.10.3 The Apple II Computer

This "system" obviously is not a military item, but it vividly demonstrates the value of some form of P³I. The Apple II, introduced in 1976, had sales of approximately 500,000 in 1983, a remarkable achievement considering that the 1976-1983 period represents two or three generations in the rapidly evolving microcomputer world. Perhaps the most significant design feature of the Apple II that accounted for this performance is the inclusion of seven expansion "slots" in the initial design, allowing peripheral cards to be easily developed and easily inserted into the computer to enhance its capabilities. Peripheral cards have been developed to provide expanded memory, better screen display, and expanded printer capabilities such as spooling. Recent additions include cards to make the Apple a 16-bit computer; to introduce new operating systems; to triple speed using new technology microprocessers; and to perform on-line data acquisition and networking. The Apple Computer Company and most of its customers have obviously benefitted from the generalized P³I design concept that was adopted.

5.11.11 Research and Sources of Information

1. Augustine, Norman R., "P³I: An Idea Whose Time Has Come . . . Again," *National Defense*, January 1981, pp. 27-31, 62.
2. Biery, Frederick and Mark Lorell, "Preplanned Product Improvement and Other Modification Strategies: Lessons From Past Aircraft Modification Programs," The Rand Corporation, N-1794-AF, December 1981.
3. Elkins, Lt. Cdr. Marlene M., USN, "P³I Help in Reducing Weapon Systems 'Costs'," *Concepts*, Spring 1982, Vol. 5, No. 2, pp. 105-110.
4. Grosson, Joseph F., "P³I Competition, Standardization, and Systems Engineering," *National Defense*, January 1981, pp. 25-26.
5. Knox, Capt. James S. Jr., USAF, "Tied Up In Knots Trying to do P³I?", *Program Manager*, November-December 1983, pp. 33-35.
6. Lyon, Dr. Hylan B., "Pre-Planned Product Improvement," *National Defense*, January 1981, pp. 20-25.
7. Morrow, Lt. Col. G.E., USA, and Dr. Jules J. Fellashi, "A Cultural Change: Pre-Planned Product Improvement," *Concepts*, Summer 1982, Vol. 5, No. 3, pp. 16-25.
8. Sickels, Capt. S.W., USAF, Pre-Planned Product Improvement (P³I), LSSR-59-B1 Master's Thesis, Air Force Institute of Technology, USAF Air University, Wright Patterson AFB, Ohio.

5.11.12 Applicable Directives, Regulations, and Pamphlets

a. Carlucci, Frank C., Deputy Secretary of Defense Memorandum, "Improving the Acquisition Process," April 30, 1981.
b. DODI 7041.3, Economic Analysis and Program Evaluation of Resource Management, October 1972.

5.12 SOURCE SELECTION

5.12.1 Definition

Source selection is the process wherein the requirements, facts, recommendations, and Government policy relevant to an award decision in a competitive procurement of a system/project are examined and the decision is made.

DODD 4105.62 emphasizes that the prime objectives of the process are:

- To select the source whose proposal has the highest degree of realism and credibility
- To assure impartial, equitable, and comprehensive evaluation of competitor's proposals
- To maximize efficiency and minimize complexity of the solicitation, the evaluation, and the selection decision

5.12.2 Problem Addressed

Source selection addresses a rather clearly defined problem, faced several times during the life of a system program: which contractor source or sources will provide the most beneficial product or service to the Government. Source selection itself may present problems for the Program Manager in terms of execution, but its applicability is not at issue. Although there are alternative forms of source selection, contracting specialists will help recommend the appropriate form for each solicitation on the basis

of such factors as program size, technical complexity, and number of sources. Source selection is especially critical at Milestones I and II; Milestone III and subsequent production source selections can be important if a multiple-source strategy is followed to maintain competition.*

5.12.3 Alternative Forms

As previously mentioned, there are several types of source-selection formats. Their key features and applicability are illustrated in Table 5-10.

5.12.4/5 Advantages/Disadvantages

As an integral part of contracting, source selection is a process to be used when and where applicable. Thus an advantages/disadvantages comparison is applicable only in comparing the various alternative forms (illustrated in Table 5-11).

5.12.6 Application Criteria

Several criteria affect the format of the source-selection process:

- Clarity and completeness of the requirement. Competition for products (and services) that are simple to describe and price may result in a formal advertising approach, whereas negotiated procurement is usually chosen in more complex solicitations.
- Size of the procurement. Full DODD 4105.62 procedures are required for major programs. Lesser programs can use more streamlined service processes.
- Urgency of requirement. Occasionally, the military necessity enables extraordinary tailoring of the selection process.

Care must be taken to ensure that the essential objective of an impartial, equitable, and comprehensive evaluation is not compromised. Because of this, the Program Manager is strongly urged to have the advice and counsel of procurement officials in planning or executing source selections.

5.12.7 Analysis and Development

The Program Manager's major analytical task is to ensure that the source-selection approach provides the best possible communication of what the Government needs and what industry can provide. The following are some of the ways in which this communication process can be helped.

- *Thorough risk analysis. This is undoubtedly the* key first step once the requirements have been established and validated. The analysis will identify the critical areas of technical and cost sensitivity for inclusion in the solicitation package.
- Integrated and simultaneous preparation of the RFP, SSP with evaluation criteria, and a model contract.
- Release of draft RFPs to industry well in advance of formal release date.
- Use of "Murder Boards" at field and system command levels.

DODD 4105.62 and the implementing service instructions (e.g., AFR 70-15, NAVMATINST 4200.49, AR 715-6) outline the activities of the solicitation, evaluation, and source-selection process. Great care must be taken to adhere to established FAR procedures. The Program Manager, in approaching source selection, must confront the following issues:

- Solicitation
  - Are there enough technically competent and interested bidders?
  - Is the RFP (and subsequent proposal) aligned with program requirements?
  - Was there undue preproposal influence that determined or influenced the technical approach? If so, will it preclude effective competition?
  - Does the program enjoy enough headquarters and Congressional support to warrant contractor interest?
- Evaluation
  - Is the process scheduled late enough to take advantage of previous phases' results, and yet early enough to be completed to support milestone decision points?
  - What is the role of the Program Manager: active head of Source Selection Evaluation Board (SSEB), advisor to Source Selection Advisory Council (SSAC), or disinterested observer?
  - Will proposal evaluation support be continuously available?
  - Are adequate administrative resources available to meet schedule and regulatory requirements?
- Source Selection
  - Do the proposals present credible approaches for meeting the program's operational and technical objectives?

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*Note: Because source selection, by definition, involves "an award decision in a competitive procurement," this section does not address the issue of sole source versus multiple sources for contractor selection.

TABLE 5-10

KEY FEATURES AND APPLICABILITY OF SOURCE-SELECTION FORMATS

Type	Steps	Applicability
Formal Advertising		
Standard	Select lowest price from qualified sources responding to Invitation for Bid (IFB)	Clearly defined requirements Fixed Price (FP) or FP with escalation contract
Two-Step	1. Request for technical proposals 2. Evaluate bids and make award from technically qualified sources	Only when - No complete specifications or purchase description - Adequate technical criteria - More than one technically qualified source - FP or FP with escalation contract
Negotiated		
Standard (Three-Step)	1. Request for technical and cost proposals 2. Negotiated with all in competitive range 3. Award	Specific situations defined by FAR Widely used in DoD acquisition management
Four-Step	1. Receipt and evaluation of technical proposals 2. Establish competitive range through evaluation of cost proposals 3. Selection of apparent winner 4. Negotiation and award of contract with apparent winner	Specific situations defined by FAR Generally only on large procurements

– Is cost realism properly considered to preclude "buy-ins"?
– Will a need for consensus on the SSEB and SSAC lead to the selection of overly conservative solutions?
– Will a lack of experience or demonstrated capability by an offeror result in inadequate consideration of perhaps a technically superior approach?
– Does the formal source-selection procedure enable the Source Selection Authority (SSA) to consider demonstrated past performance, judgment, and common sense?

5.12.8 Functional Interfaces

Source selection, as part of contracting, is of most direct interest to the business/financial strategy. It

TABLE 5-11 ADVANTAGE/DISADVANTAGE COMPARISON OF ALTERNATIVE SOURCE-SELECTION FORMATS	
Advantages	Disadvantages
Formal Advertising - Standard	
Most competitive basis Usually shortest procurement cycle	Requirement must be very specific Least control of source selection by requiring agencies
Formal Advertising - Two-Step	
Useful in procurement of complex technical items Can result in specifications useful for subsequent advertised procurements	Initial step may eliminate acceptable lowest-cost source Increased time required to select source
Negotiated - Standard	
More data available with which to evaluate competitors Can handle higher degree of technical uncertainty of requirements Greater contractor data requirements	Cost of proposal preparation may restrict competition FAR restricts use of negotiated procurement
Negotiated - Four-Step	
Guards against technical leveling Lower contractor cost if not selected (earlier indication of apparent source)	Loss of competitive advantage before negotiation with apparent source Limited use by Government results in contractor unfamiliarity with approach

is through source selection that the design is chosen (as functional, allocated, or production design); the selection is influenced by T&E achievement, and it determines when and where production will occur. Other strategies cannot help but be influenced by the preparation for and execution of source selection.

Functional Interfaces:
Source Selection

Design	X
Test and Evaluation	X
Production	X
Deployment	X
Personnel/Organization	X
Schedule	X
Business/Financial	Primary
Management Information	X
Facilities	X

5.12.9 Time Line

Source selection process can take place many times throughout the life of a program. Program Managers, in laying out their program master schedule, must block out adequate time for the myriad activities involved in the process, including:

- Procurement Request (PR) preparation and approval
- Determination and Findings (D&F)/Justification and Authority for Negotiation (JAN) preparation and approval
- Acquisition Plan preparation and approval
- RFP preparation and approval
- Source Selection Plan (SSP) preparation and approval
- Commerce Business Daily (CBD) notification
- RFP release
- Bidder's briefing, and response to technical questions and clarifications
- Proposal receipt and evaluation
- Best and Final Offer request and evaluation
- Negotiations
- Legal reviews

Source selection can be time-consuming; recent experience indicates that the period from initiation of the RFP to actual contract award can be as long as 18 months. The various source selections can be portrayed as follows:

Time Line: Source Selection

Milestones

	0	1	2	3
Decision	•	•	•	•
Implementation	—	—	—	—....

5.12.10 Recent Experience

Stringent legal requirements make source selection one of the best documented activities in acquisition management.

As one of the documentation requirements for every major source selection (AFR 70-15, para. 1-14), the Air Force prepares "Lessons Learned" to discuss problems encountered and recommended solutions. Each Program Manager, before initiating source selection action, can gain valuable insights by reviewing these lessons. Contracting specialists at field locations or within the system command headquarters (see Section 5.2.11) can furnish the currently most important issues in source selection.

5.12.11 Sources of Information

1. Gordon, Dr. H.J., "Initiatives in Source Selection and Contractor Performance Evaluation," *Program Manager*, Vol. 9, No. 4, 1980.
2. Helmer, Lt. Col. F.T. and Maj. R.L. Taylor, *A Conceptual Model for Evaluating Contractor Management During Source Selection*, Department of Economics, Geography, and Management, USAF Academy, Colorado, March 1976.
3. Nassr, Col. M.A., "Past Performance: An Essential Element in Source Selection," *Defense Systems Management Review*, Vol. 1, No. 7-8, 1978.
4. Reinhard, M.J., "Improving the Source Selection Process," *Concepts*, Vol. 5, No. 3, 1982.
5. Spigarelli, Lt. Col. R.F., "Multinational Source Selection," *Program Manager*, Vol. 11, No. 3, 1982.
6. Williams, R.F., "Problems in Numerical Input for the Source Selection Process," *Concepts*, Vol. 3, No. 3, 1980.

Note: Procurement specialists are available at the following system command staff offices to assist Program Managers in source-selection planning and execution:

- Army – DARCOM/DRCPP-M, 202-274-8241
- Navy – NAVMAT 022, 202-692-8681
- Air Force – AFSC/PMPR, 301-981-4718

5.12.12 Applicable Directives, Regulations, and Pamphlets

a. DODD 4105.62, Selection of Contractual Sources for Major Defense Systems, 6 January 1976.
b. AR 715-6, Proposal Evaluation and Source Selection, 21 September 1970.
c. DARCOM Pamphlet 715-3, Proposal Evaluation and Source Selection, October 1980.
d. NAVMATINST 4200.49, Selection of Contractual Sources for Major Defense Systems, 28 February 1977.
e. AFR 70-15, Source Selection Policy and Procedures, 16 April 1976.
f. *Federal Acquisition Regulations*, 1 April 1984.
g. AFSCR 70-2, Air Force Systems Command Business Strategy Panel, 2 May 1980.
h. AFSCR 70-4, Request for Proposal Preparation Guide, 2 June 1983.
i. AFSCR 70-7, Air Force Systems Command Procurement Evaluation Panel, 2 May 1980.

5.13 STANDARDIZATION

5.13.1 Definition

Standardization is "the process by which the Department of Defense achieves the closest practicable cooperation among the Services and Defense agencies for the most efficient use of research, development, and production resources, and agrees to adopt on the broadest possible basis the use of:

"a. Common or compatible operational, administrative, and logistic procedures
"b. Common or compatible technical procedures and criteria
"c. Common, compatible, or interchangeable supplies, components, weapons, or equipment
"d. Common or compatible tactical doctrine with corresponding organizational compatibility." (Reference 3)

A standard can be a written set of technical or performance requirements applied to hardware or software. It can also be an accepted process or procedure. Finally, it can be a common product identified as a preferred item.

5.13.2 Problem Addressed

Constraints on military resources prompt searches for methods to improve operational capability while reducing costs during acquisition and throughout the life cycle of weapon systems and equipments. One method is to purchase components or equipments that are common within a service or are used by other services or by other countries. The higher-volume purchase is expected to result in lower costs and a larger source of supply. In addition, more common equipments are sometimes subjected to more comprehensive reliability-improvement programs. Such efforts are usually slanted toward the "hardware" aspects of weapons systems, but software is equally sensitive to cost and operational concerns, and efforts have moved forward in DoD on common higher-order languages (e.g., Ada).

5.13.3 Alternative Forms

Standards can take many forms. It is important to note that rarely can standards be implemented completely at the weapon system level. However, partial standardization at the subsystem and component levels can still achieve high return for a program.

The selection of standards can be drawn from a variety of sources:

- Commercial Item Descriptions (CIDs), simplified federal specifications that describe physical or functional characteristics of acceptable commercial products. They can be recognized by the identifier "A-A-" (e.g., A-A-50652 "Life Preserver, Vest").
- Federal Specifications, which also describe commercially available products but provide additional technical details. The classification includes two groups of letters. The first group identifies the commodity, and the second is the first letter of the title (e.g., HH-I-524, "Insulation Board, Thermal").
- Federal Standards, which address engineering or management processes, e.g., FED-STD-4, "Glossary of Fabric Imperfections."
- Military Specifications, which describe intrinsically military products and are preceded by "MIL" or "DoD" (for documents in the metric system), e.g., MIL-W-5013, "Wheel and Brake Assemblies, Aircraft."
- Military Standards, which describe engineering and management processes. The titles are preceded by "MIL-STD," "DoD-STD" (for metric standards), or "MS" (if on sheet form), e.g., MS-27423, "Protector-Propellor Shaft, Plastic."

Other related documents include Qualified Parts Lists (QPLs), handbooks, international standards (such as NATO Standardization Agreements or STANAGs), and nongovernment (voluntary) standards that have been adopted as satisfactory for military use in certain circumstances.

The overall trend in military standardization today is to emphasize interface standards, rather than component standards, because the fast-moving technology base often renders specific components obsolete before the system is fielded. The reasonable use of appropriate interface standards permits the greatest design flexibility by the developer and permits easier insertion of technology into the system after fielding (see P^3I discussion). Form-fit-function (F^3) standards are one form of interface standards that permit interchanging subsystems among several suppliers without dictating the details of design or selection of components.

The Program Manager would be wise to consult with the Defense Material Specifications and Standards Organization (DMSSO) regarding the availability of standards relevant to the program or the process of creating new standards.

5.13.4 Advantages

The word "standardization" evokes strong reactions, both positive and negative, in the acquisition community. To the technologist, the requirement to use standards is often considered constraining. Other members of the acquisition community recognize that standards represent the accumulated experience of many efforts and provide useful guidance in designing, testing, selecting, integrating, and producing elements in the system to be acquired. The use of standards or standard items will usually reduce logistics costs significantly. Development and acquisition costs will be reduced if the standard is a reasonable alternative to an element in the system architecture.

Other advantages are:

- Reduction of unnecessary proliferation. This results in savings in manpower and money.
- Time savings. The development and qualification of new items often takes longer than the Program Manager or manufacturer anticipates.
- Risk reduction. Standard parts that are in wide use have established performance and reliability histories.
- Enhancement of competition. The existence of a standard and associated documentation permits the introduction of new suppliers.

When properly applied, standardization can significantly improve the Program Manager's chances of delivering a program on time, within cost, and with a better understanding of the performance to be expected in the field.

5.13.5 Disadvantages

Since standards are often created to accommodate worst-case situations, they may be too stringent for some applications, resulting in unnecessary costs or other penalties such as greater weight or additional space. Overzealous application of standards may also restrict the incorporation of newer technology in the system or in processes used producing the system.

5.13.6 Application Criteria

The following criteria (excerpted from Reference a) should be applied in determining the applicability of standards to an acquisition program.

- The technological maturity of the product or process. For emerging technologies it may not be possible or advantageous to commit to a specific approach.

- The maintenance concept. For equipment designed to be maintained or thrown away at the subassembly level, for example, the configuration of components may be of no importance.
- The principal use or user. Certain users have developed expectations regarding the ruggedness or other features of a product. Failure to use accepted standards could affect the operational concept of employment.
- The experience level of potential suppliers. DoD encourages the widest possible participation in the supplier base. In some instances it may be necessary to evoke a standard to ensure that the newer participants are following acceptable design or testing procedures.
- The end application of the product. Interoperability considerations or the requirement for alternative sources may dictate the application of certain standards or standard parts.

5.13.7 Analysis and Development

Standard life-cycle-cost (LCC) analysis techniques are the most useful methods for conducting standardization trade-offs. The LCC analyses are facilitated because cost and performance data are normally readily available for standard parts.

To help determine the characteristics and availability of specifications or standards, the Program Manager should obtain the DoD Index of Specifications and Standards (DODISS) (Reference c). Other useful information for the trade-off analyses may be found in References d and e.

The analysis normally involves the development, by respective suppliers, of cost-quantity curves for selected parts in quantities needed to assemble the unit. Sources are then asked to bid on a design that will accomplish all of the functions for those individual parts. The unit cost for small numbers of a "universal part" is often higher, but the cost-quantity discounts for the total demand often make the standard item more desirable as illustrated in Figure 5-10. Unit cost estimates can then be used in life-cycle-cost analyses. Other factors not sensitive to quantity must be added to or subtracted from the variable-cost calculation as appropriate, e.g.,

- R&D costs
- Costs of entering new items into Government inventory
- Costs of training technicians to replace or repair new items
- Documentation

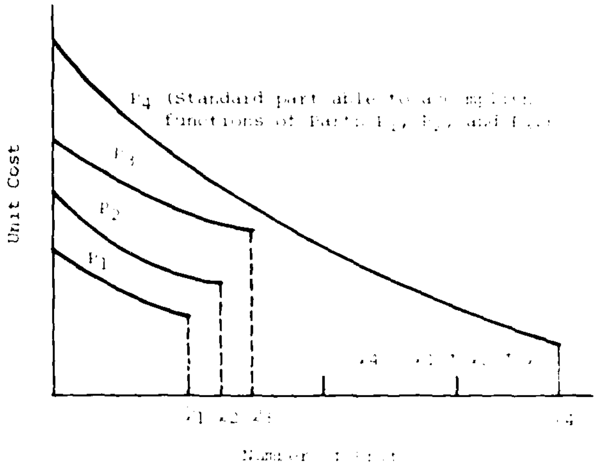

FIGURE 5-10

STANDARDIZATION TRADE-OFF ANALYSES

5.13.8 Functional Interfaces

Standardization has an impact on design strategy in the selection of components or equipments to be standardized, but it also affects Test and Evaluation, Production, Deployment, Business/Financial, and Management Information. Standardized components may not have to be tested except at the system level, may already be in production and in the field, may foster competition with nonstandard components, and may require data tracking to permit configuration management and to ensure that they meet all specifications.

Functional Interfaces:
Standardization

Design	Primary
Test and Evaluation	X
Production	X
Deployment	X
Personnel/Organization	
Schedule	X
Business/Financial	X
Management Information	X
Facilities	

Schedule is another area of primary interface. The impact here can be either positive or negative. If a mature standard or standard item is available, the schedule can be shortened accordingly. If the standard is still in development, the program schedule may have to be adjusted to accommodate coordination and testing of the new process or article.

5.13.9 *Time Line*

It has been said in the acquisition community, with tongue-in-cheek, that there are two times to standardize: too early, and too late! In the conceptual stages of a program, no one wants to constrain the design of the system with standards based on older technology. As the system develops, it is difficult to accommodate standards within this unconstrained architecture. Thus the timetable for standardization considerations is difficult to establish.

The Program Manager will first confront issues in standardization in the directives that establish the program. The program is normally expected to conform to broad architectural hardware and software standards (such as the MIL-STD-1553 multiplex bus interface and the Ada higher-order language) in the program direction, or show convincingly why such standards do not make sense from the viewpoint of performance, cost, schedule, or risk. Sometimes, strong rationale for exemption provided by the Program Manager will be overruled by higher authority in the interests of force-wide logistics considerations or interoperability.

Government technical experts preparing the specification for procurement are knowledgeable about the many standards for ensuring successful operation in a military environment. For example, standards such as MIL-E-5400 are evoked in the procurement to ensure operation in the temperature, altitude, and environmental regime for military aircraft electronics. These standards must often be tailored for specific application. The Program Manager must take care that these standards are not applied capriciously, since overdesign will increase system cost unnecessarily (see References 2 and 5).

The final area where standards are encountered are the standards established by industry. These standards are by far the most successful, because they are voluntary and self-enforced. They are normally established by industry associations or professional societies such as the Society of Automotive Engineers or the IEEE, and they are in widespread use. Examples of industry standards employed by the military include the IEEE 488 computer bus, ANSI computer standards, and the SAE lubricants standards. The use of such standards is often proposed by the contractor in the response to requirements stipulated by the Government. The Government normally encourages the use of these standards, unless they do not meet interoperability or performance requirements of the system concept.

Time Line: Standardization

	Milestones			
	0	1	2	3
Decision			•	
Implementation			———	———

5.13.10 Recent Experience

The literature abounds in experiences, good and bad. The DoD's attempt to establish the F-111 as a standard for the Air Force and Navy was a particularly bitter experience. Recent weapon system standardization experience in international programs has differed; Roland (Europe to U.S.) has not been totally successful; the F-16 (U.S. to Europe) has been quite successful.

The airlines have been successful in maintaining a healthy level of competition among their avionics suppliers through the use of F^3 standards since the 1950s. Savings exceeding 30 percent of acquisition cost have been documented for this approach. Even higher savings have been reported by the military in a few cases. The success of the airlines and the military in applying form-fit-function standards to avionics is summarized in Reference 1.

Standardization has been most successful when applied to the subsystem level for technologies that are relatively mature. Thus the ARC-164 radio, the ARN-118 TACAN, and the Navy's Standard Electronic Module Program have good records of cost savings and reliability improvements. Engines and engine components have achieved or are expected to achieve success in varying degrees, most recently in the Army T-700 program, the Navy F-404 program, and the Air Force/Navy F-110 program.

Radar and electronic warfare programs have not achieved much standardization success, primarily because of the dynamism of the technologies. The Air Force ALR-69 and Navy ALR-67 radar warning receivers are built by the same manufacturer at the same time for the same threat environment; yet they are not interchangeable. However, the services have been successful in achieving multiple platform applications for these receivers within their respective aircraft fleets. The F-16 fire control radar has found partial application (subsystem level) to the Army DIVAD program.

5.13.11 Research and Sources of Information

The Military Departments and DoD are investigating the application of standardization to achieve enhanced competition, manufacturer sustainability,

reliability/maintainability/durability improvements, and lower life-cycle cost. Publications include:

1. "F³ Standardization—Does It Work?" S. Baily, ARINC Research Corporation, Annapolis, Maryland, 1983.
2. Hershfield, C. and Iormey, Jr., "Making Tailoring Work," *Defense Systems Management Review*, Vol. 2, No. 3, 1979.
3. JCS Pub. 1., Department of Defense Dictionary of Military and Associated Terms, The Joint Chiefs of Staff, Washington, D.C., 1979.
4. Lidy, Lt. Col. A.M., USA, "NATO Standardization—An Alternative Approach," *Defense Systems Management Review*, Vol. 1, No. 3, 1977.
5. Matthews, Dr. W.E., "Toward More Effective Implementation of Specification Tailoring," *Defense Systems Management Review*, Vol. 1, No. 7-8, 1978.
6. Ragano, Brig. Gen. F.P., USA, "US Roland—A Giant Step Toward Weapon Commonality," *Defense Systems Management Review*, Vol. 1, No. 3, 1977.
7. Shea, Dr. J.F., "Background of Study on Specifications and Standards," *Defense Systems Management Review*, Vol. 2, No. 3, 1979.
8. Stoney, W.E., "The Process of Standardization—An Overview," *Defense Systems Management Review*, Vol. 1, No. 3, 1977.

5.13.12 Applicable Directives, Regulations, and Pamphlets

a. An Overview of the Defense Standardization and Specification Program, Publication SD-8, 1 May 1983. Office of the Under Secretary of Defense for Research and Engineering, Washington, D.C.
b. DoD 4120.3M, Defense Standardization Manual, U.S. Government Printing Office, Washington, D.C.
c. DoD Index of Specifications and Standards (DODISS) (available in print and microfiche), Naval Publications and Forms Center, Philadelphia, Pennsylvania.
d. Standardization Directory, Publication SD-1, Naval Publications and Forms Center, Philadelphia, Pennsylvania.
e. Status of Standardization Projects, Publication SD-4, Naval Publications and Forms Center, Philadelphia, Pennsylvania.

5.14 TEST AND EVALUATION—RELIABILITY GROWTH

5.14.1 Definition

Testing provides information that reduces uncertainty about achieving program objectives. There are different types of testing that are appropriate for specific phases in weapon systems acquisition. Early prototype testing in Demonstration and Validation may be performed at the component, subsystem, or system level. During Full Scale Development, development testing, demonstration testing, and initial operational testing may be employed to varying degrees. Acceptance testing is applied to production articles during FSD and Production and Deployment. Operational testing and joint services testing may be utilized during the Production and Deployment phases.

This section addresses only one type of testing: Reliability Growth during FSD utilizing a Test, Analyze, and Fix (TAAF) approach. TAAF is a testing philosophy associated with developmental testing of hardware to improve the reliability of systems and equipment. Such development testing emphasizes reliability growth by using an iterative test-redesign-retest process that identifies corrective action to improve equipment design and manufacturing processes. It is more design-focused than demonstration testing. Reliability-growth measurement and tracking can provide the Program Manager with insight into actual versus planned progress in achieving system reliability. It is one tool for assessing technical risk and the readiness of a program to transition from development to production.

5.14.2 Problem Addressed

Many programs enter operational inventory with hardware that cannot achieve readiness or availability objectives. It is very expensive to correct deficiencies in the field and introduce improvements to obtain the original operational reliability objectives. A reliability-growth program during FSD can be beneficial in achieving higher reliability in components, subsystems, or systems. TAAF testing is a possible alternative that the Program Manager may wish to

select in trying to achieve improved operational reliability.

5.14.3 Alternative Forms

Reliability growth (TAAF) must be planned from the outset of a development program. Decisions must be made concerning which specific subsystems or components are expected to present problems, such that a reliability-growth program would be beneficial, and how much of the program resources should be devoted to this activity. Resources of time, hardware, personnel, and facilities must be devoted to the TAAF program. A failure-reporting and corrective-action feedback system is a necessity.

5.14.4 Advantages

TAAF is employed as early in the development process as practical. Achieving reliability growth through TAAF permits the deployed system to obtain higher readiness/availability rates while consuming fewer resources in support of that readiness. TAAF can provide better operational capabilities while reducing the logistics support costs of spare parts.

5.14.5 Disadvantages

Reliability growth requires resources – time, money, people, and facilities – early in the development program to achieve the test results and to improve and mature the design before transition to full production. It is necessary to decide early in the program what TAAF testing will be conducted for subsystems or components and how much time and money can be made available for specific programs. TAAF testing can cost a significant amount, for instance, as much as 5 to 10 percent of the development program.

5.14.6 Application Criteria

Reliability-growth testing should be conducted for components or subsystems that are expected to present problems on the basis of previous experience or that are so technologically advanced that no previous data base exists. Electronic equipment and avionics are particularly amenable to reliability-growth testing, but so are aircraft or missile mechanical subsystems such as landing gear, propulsion, and auxiliary power systems.

5.14.7 Analysis and Development

The analysis of reliability-growth testing using TAAF is based on the development and tracking of reliability-growth curves using standard reliability models. A TAAF program is designed to provide substantiation that a certain reliability growth can be obtained. Figure 5-11 is an example of planning a TAAF reliability-improvement program. Estimates are made for the slope and initial point from which the reliability growth begins. The initial point may be estimated on the basis of previous testing of prototype systems or previous experience with similar systems. For example, a prototype may have been tested during the Demonstration and Validation phase, or previous programs may have appropriate test and operational experience. The initial point also reflects the complexity and technology advance expected in the particular program. The slope is estimated in a similar manner. The test hours required and sets of hardware needed to achieve those test hours for a planned test schedule are then estimated and compared with what was desired in the program test plan.

Figure 5-12 illustrates an actual experience. To be effective in a test-redesign-retest iterative process, TAAF should be coupled with an effective closed-loop failure reporting, analysis, and corrective-action system. In addition, a rigorous configuration management control system is required to track modifications of system elements during the testing period.

5.14.8 Functional Interfaces

TAAF testing is implemented during Full Scale Development. The primary functional interface is with testing. Other functional interfaces include design, production, deployment, personnel/organization, schedule, business and financial, management information, and facilities. Thus the test program will have an impact on all functional strategies, an indication of the importance of careful consideration early in the formulation of acquisition strategy.

Functional Interfaces:
Reliability Growth

Design	X
Test and Evaluation	Primary
Production	X
Deployment	X
Personnel/Organization	X
Schedule	X
Business/Financial	X
Management Information	X
Facilities	X

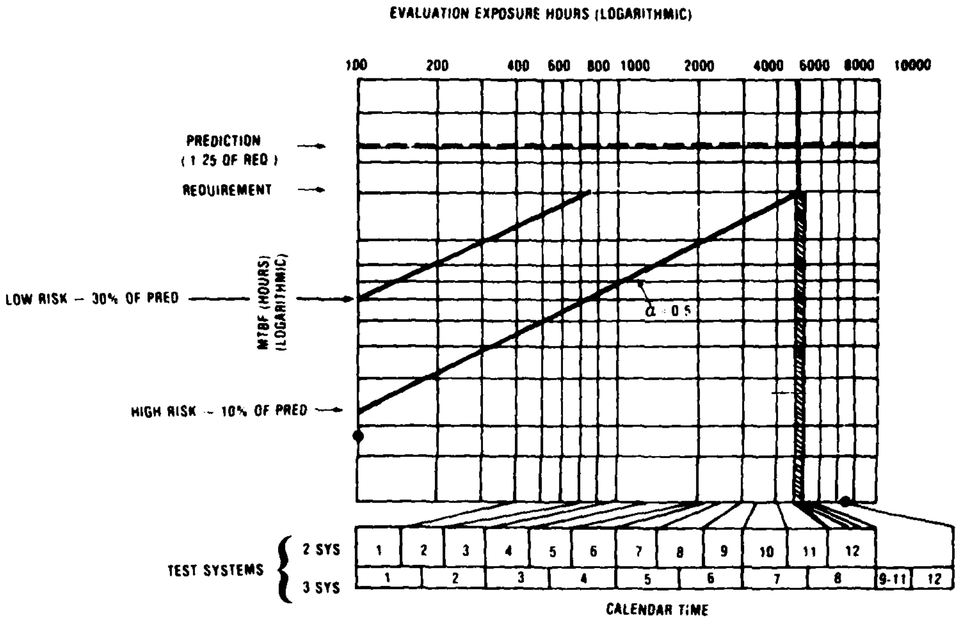

FIGURE 5-11

RELIABILITY DEVELOPMENT TEST PLANNING MODEL

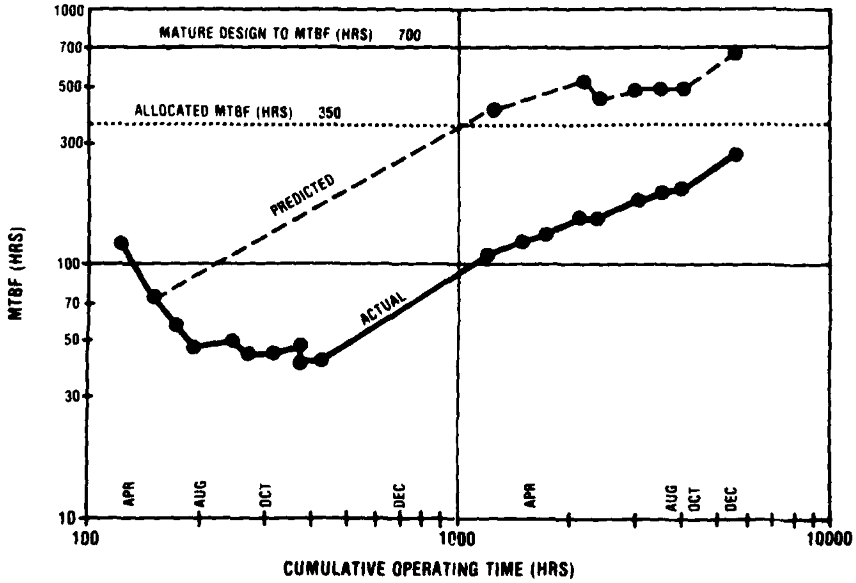

FIGURE 5-12

RELIABILITY-GROWTH TRACKING CHART

5.14.9 Time Line

The need for TAAF testing should be recognized no later than the Demonstration and Validation phase, and decisions on which components or subsystems will be subjected to TAAF testing should be made prior to the request for proposal for Full Scale Development. The TAAF testing funding is then incorporated as part of the development program and should be protected for that purpose.

Timeline: Reliability Growth

	Milestones			
	0	1	2	3
Decision		•		
Implementation			—	

5.14.10 Recent Experience

A substantial reliability-growth TAAF testing effort was undertaken during the F-18 DT&E for selected avionics and mechanical systems. It is estimated that the TAAF testing added $100 million to the RDT&E program but will save the program many times that amount through lower operational support costs throughout its life cycle.

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5.14.12 Applicable Directives, Regulations, and Pamphlets

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5.15 WARRANTIES/GUARANTEES

5.15.1 Definition and Concepts

A warranty or guarantee is a commitment provided by a supplier to deliver a product that meets specified standards for a specified period of time. As far as is known, there is no clear-cut distinction between the term "warranty" and the term "guarantee" as applied to military system acquisition. We shall use the following definitions for discussion purposes:

- Warranty—an obligation of the contractor undertaken through a fixed-price contract to repair or replace equipment found to be defective during the period of warranty coverage.
- Guarantee—a commitment embodying contractual incentives/penalties for achieving specified field operational goals.

5.15.2 Problem Addressed

Incentives are the main thrust of warranties/guarantees, and reliability/maintainability are the characteristics typically addressed. Reliability, in particular, is an elusive parameter—difficult to define, estimate, and measure. It is not uncommon for field reliability to be one-third or less of that exhibited through a MIL-STD-781 demonstration test. A contractor does not generally have an inherent motivation to spend any more effort on reliability than is necessary to pass the MIL-STD-781 test. The typical DoD acquisition process does not provide the commercial marketplace environment that can assign a valuable premium to producers of highly reliable equipment.

With a properly structured warranty or guarantee, the contractor is committed to meet operational requirements. For example, with a Reliability Improvement Warranty (RIW) the equipment is covered for a long duration, typically three or more years with a contractor commitment for depot-type repair. The price paid for the RIW should be related to a specified or negotiated field reliability level. If the actual reliability is lower than the target, more failures occur and the contractor will have to pay for additional repair out of his own resources. If the reliability level is better than the target, the contractor keeps some of the RIW money as additional profit. The RIW concept can therefore provide very positive motivation to contractors to provide extra design,

test, and production efforts to ensure that field reliability is satisfactory.

In the Defense Appropriations Act of 1984 (PL98-212), Congress included a section (Section 794) that states in part "No funds . . . may be obligated or expended for the procurement of a weapon system unless the prime contractor or other contractors for such system provide the United States with written guarantees." The guarantees must stipulate:

- That the system and components conform to contractual performance requirements.
- That the system and components are free from defects that would cause failure to meet performance requirements.
- That, in the event of failure, the contractor will bear the cost of achieving required performance.

This Act, if interpreted and implemented in its broadest sense, would make warranties and guarantees a standard, not special, feature of most fixed-price production contracts. In past practices, the use of a long-term warranty/guarantee in a Government contract had to be justified on a cost-effectiveness basis. The new Act now requires justification on a cost-effectiveness basis for not using a warranty/guarantee. DoD is developing guidance for implementing this part of the Appropriations Act. Continued interest and concern in this area is expected. The latest guidance should be reviewed.

5.15.3 Alternative Forms

Warranty and guarantee are distinguished by the repair/replace commitment of the warranty versus the incentive/penalty provisions of the guarantee. In some contracts the two approaches have been used together; i.e., the contractor warrants that the equipment will perform as specified for X years. If it fails, the contractor will repair or replace it at no additional cost to the Government. The contractor also guarantees that the equipment will have a field MTBF of H hours. If the measured MTBF is less than H, the actions necessary to correct the problem will be performed. Until the MTBF requirement is met, the contractor may provide consignment (loaner) spares to compensate for the reduced readiness caused by the low MTBF or provide other compensation. If the MTBF is higher than H, a monetary incentive may be provided.

Generally, the use of warranties/guarantees is applicable only for fixed-price contracts (FAR 46.705). In many acquisitions, warranty/guarantee is an option to be separately priced in a proposal for evaluation by the Government. This section concentrates on three types of warranties/guarantees that have received the greatest attention to date. Reliability Improvement Warranty (RIW), MTBF Guarantee (MTBFG), and Logistics Support Cost Commitment (LSCC). The salient features are summarized in Table 5-12.

5.15.4 Advantages

The advantages of warranties and guarantees are as follows:

- Direct and indirect motivation for designing and producing reliable and maintainable equipment
- Reduced life-cycle costs if R&M motivation is successful
- Transfer of part of R&M risk to the contractor
- Reduced initial requirements for support equipment, training, and data (warranty)
- Significant portion of support costs known at outset (warranty)
- Reduced initial logistics problems if contractor repair is at "black box" level
- Long-term, stabilized work flow for contractor and increased chances for follow-on (warranty)
- Control of operational rather than test parameters (guarantee)
- Trade-off potential for guarantee of higher-level parameters (e.g., logistics support costs)

5.15.5 Disadvantages

Disadvantages associated with warranty/guarantee are as follows:

- Pricing risks can be large.
- Tailored provisions are required, increasing the complexity of the procurement process.
- "Up-front" costs are increased to cover contractor risks and commitment.
- Sparing is at the black-box level rather than the module level (warranty).
- There are large step increases in military maintenance responsibility at warranty termination.
- The potential for legal disputes is increased.
- Accurate field measurements are required, together with valid models and representative sampling situations (guarantee).
- Large dollar expenditures could depend on a relatively small sample (guarantee).

TABLE 5-12

FEATURES OF ALTERNATIVE WARRANTY/GUARANTEE PLANS

Features	RIW	MTBF Guarantee	LSC
Objective and Maintainability	Secure reliability improvement/reduce support costs.	Achieve stated reliability requirements/reduce support costs.	Achieve stated logistics cost goal.
Method	Contractor repairs or replaces all applicable items that fail during coverage period; implements no-cost ECPs to improve reliability/maintainability.	Guaranteed field MTBF stipulated. Contractor provides consignment spare units to maintain logistics pipeline if guarantee is not met. Spares kept by Government if MTBF does not improve.	Normal military maintenance; operational test using a specific model performed to assess LSC; penalty or corrective action required if goals are not achieved.
Pricing	Fixed price.	Fixed price.	Fixed price or limited cost sharing for correction of deficiencies.
Incentive	Contractor profits if costs are lower than expected because of improved R&M.	Severe penalty for low MTBF. Can include a positive incentive if MTBF exceeds guarantee value.	Award fee if goal is bettered; penalties for poor cost performance.

5.15.6 Application Criteria

Table 5-13 presents a set of criteria developed for evaluating warranty/guarantee (Reference 2). The criteria are grouped in three areas: procurement factors, system or equipment characteristics, and operational factors. While the areas are of equal importance, some of the criteria are more important than others. Three classes of importance have been established. The criteria shown in Table 5-13 are rated according to these classifications:

- Major. Failure to meet the stated criterion could be grounds for not using warranty/guarantee.
- Secondary. Failure to meet the stated criterion will generally not be a sufficient basis for rejecting warranty/guarantee, but a combination of such events could be.
- Minor. Failure to meet these criteria is generally not considered serious, but it may require special consideration in structuring the warranty/guarantee contract or administrative procedures.

5.15.7 Analysis and Development

As in any form of incentive contracts, the key elements in determining the suitability and structure of a warranty/guarantee are risk/uncertainty, control, and motivation. The primary analysis methods used in the past are evaluations of application criteria and life-cycle cost.

In Table 5-13, the application criteria suggested for RIW, RIW/MTBF, and LSCC were presented. Using the criteria in a check list manner, one can determine if so many critical factors do not meet the

TABLE 5-13

WARRANTY/GUARANTEE APPLICATION CRITERIA

Criteria	Importance Rating*		
	RIW	RIW/MTBF	LSC
Procurement			
The procurement is to be on a fixed-price basis.	1	1	1
Multiyear funding for warranty services is available.	1	1	N/A
The procurement is competitive.	2	2	2
Potential contractors have proven capability, experience, and cooperative attitude in providing warranty-type services or LSC commitment.	2	2	2
The procurement quantity is large enough to make warranty economically attractive.	2	2	N/A
Analysis of warranty price versus organic repair costs is possible.	2	2	N/A
An escalation clause is included in the contract that is applicable to warranty or LSC costs.	3	3	3
The equipment will be in production over a substantial portion of the warranty period.	3	1	2
Equipment			
Equipment maturity is at an appropriate level.	1	1	2
Control of unauthorized maintenance can be exercised.	1	1	2
Unit is field-testable.	1	1	N/A
Unit can be properly marked or labeled to signify existence of warranty coverage.	1	1	N/A
Unit is amenable to R&M improvement and changes.	1	1	3
Unit is reasonably self-contained.	2	2	3
Unit can be readily transported to the contractor's facilities.	2	2	N/A
Unit has high level of ruggedization.	2	2	N/A
Unit maintenance is highly complex.	3	3	N/A
An elapsed-time indicator can be installed on the equipment.	3	1	1
Operation			
Use environment is known or predictable.	1	1	1
Equipment operational reliability and maintainability are predictable.	1	1	1
Equipment wartime or peacetime mission criticality is not of the highest level.	1	1	N/A
Equipment has a high operational utilization rate.	2	2	3
Warranty administration can be efficiently accomplished.	2	2	N/A
Duplication of an existing or planned Government repair facility is not costly.	2	2	N/A
Unit reliability and usage levels are amenable to warranty maintenance.	2	2	N/A
Operating time is known or predictable.	2	2	3
Operational failure and usage information can be supplied to the contractor.	2	1	3
Back-up warranty repair facilities are available.	3	3	N/A
Provision has been made for computing the equipment's MTBF.	N/A	1	1

*1 = Major; 2 = Secondary; 3 = Minor; N/A = Not Applicable.

criteria that use of the option is precluded. Making such determinations for some factors could involve considerable study, e.g., evaluating the predictability of operational R&M.

Warranties/guarantees provide a means for sharing risks with respect to field performance, particularly in the R&M and support areas. To properly develop an effective warranty/guarantee strategy, it is necessary to identify and understand the risks. Table 5-14 lists generic risks associated with implementing warranties or guarantees.

In many cases the acquisition strategy can reduce these risks to a manageable level. As a simple example, for a long-term warranty the contractor may be concerned with the potential effects of inflation on pricing. By including an escalation clause in the contract for warranty materials and services, the contractor can reduce risks considerably.

The life-cycle-cost parameter provides a convenient overall measure for evaluating warranty/guarantee potential and developing terms and conditions. The basic approach is to perform life-cycle-cost analy-

TABLE 5-14

WARRANTY/GUARANTEE RISKS

Factor	Risk
Characteristic Addressed Under Warranty	The "wrong" characteristic may be selected, thereby focusing effort incorrectly.
Price	It is difficult to estimate expected field performance, which is basic measure for realistic pricing.
Operational Factors	Field stresses may be difficult to estimate, because of many unforeseen circumstances.
Self-Sufficiency	Contractor repair can reduce military self-sufficiency for wartime-critical items.
Equipment Design	Contractor may design equipment more suitable to maintenance posture than to the military maintenance environment.
Transition	Transition from contractor maintenance to military maintenance can introduce serious administrative and logistics problems.
Administrative Complexity	Procurement and logistics procedures may have to be developed to effectively implement the warranty/guarantee.

with and without the warranty/guarantee provision. By varying such critical parameters as guaranteed MTBF and coverage period, the analyst is provided with trade-off data to help in the decision process. Reference 1 provides detailed models for such analyses.

The following sequence of steps is suggested for developing and implementing a warranty/guarantee strategy:

1. Perform studies to identify characteristics to consider for warranty/guarantee and identify candidate approaches.
2. Develop criteria and models and collect applicable data to perform evaluations.
3. In conjunction with technical, user, logistics, and contractual personnel, develop candidate approaches and assess the feasibility of candidate approaches, including consideration of warranty implementation and administration.
4. Develop preliminary clauses or draft provisions and provide "trial balloons" to potential contractors to obtain industry comments.
5. Issue an FSD RFP with "expected" warranty guarantee provisions for the production contract.
6. Finalize warranty/guarantee terms and conditions for the production RFP.
7. Develop a warranty/guarantee selection strategy and decision model.
8. Issue an RFP with warranty/guarantee option.

Within the major options of RIW, MTBF guarantee, and logistics support cost commitment, there are many suboptions. For example, in one major program (the Air Force F-16), prices for the RIW, MTBF guarantee, and logistics support cost commitments were obtained at the start of Full Scale Development, when competition for the FSD and follow-on production contracts still existed.

Specifics concerning warranty/guarantee development are summarized in Table 5-15.

TABLE 5-15
DO'S AND DON'TS FOR WARRANTY/GUARANTEE DEVELOPMENT
Do's
Make the coverage time and population large enough to motivate the contractor to make the up-front investment.
Involve the contractor, user, support agency, and DCAS and other affected functional elements in the planning process.
Consider life-cycle cost as one metric for evaluating warranty/guarantee alternatives.
Simplify time-measurement, termination, and price adjustment to the maximum extent possible.
Check/double-check to ensure that concepts, terms, and conditions are clear and fully understood.
Structure terms and conditions to be consistent with operations and support procedures.
Develop adequate back-up approaches if the warranty/guarantee cannot be negotiated or implemented.
Don'ts
Do not commit the contractor to guarantee elements beyond the contractor's reasonable control.
Do not dilute the fixed-price essence of a warranty/guarantee to essentially a time-and-materials contract.

5.15.8 Functional Interfaces

All functional areas can interface with the development and implementation of warranty/guarantee approaches. Although warranty/guarantee becomes part of the contractual instrument, the focus is primarily on design, and that is why an early start on developing approaches and "publicizing" them is important.

Functional Interfaces:
Warranties/Guarantees

	Primary
Design	
Test and Evaluation	X
Production	X
Deployment	X
Personnel/Organization	X
Schedule	X
Business/Financial	X
Management Information	X
Facilities	X

5.15.9 Time Line

Since warranty/guarantee is an incentive form, maximum benefits are more likely to be attained when contractors are notified as early as possible of the intent to use warranty/guarantee provisions. In this way, appropriate design and production decisions can be made to take advantage of the positive potential offered by the commitment.

Time Line: Warranties/Guarantees

	Milestones 0	1	2	3
Decision			•	
Implementation			———	———

5.15.10 Recent Experience

A number of military programs have now accumulated experience with warranty/guarantee programs to indicate that such incentives can provide means for meeting objectives when they are properly applied. Table 5-16 summarizes 13 RIW and RIW/MTBFG programs. Field MTBF values are shown, together with either expected or guaranteed values. The last column shows the ratio of field values to expected values—a ratio greater than 1 being desired. For 12 of the 13 programs, that was the case. The average ratio (based on geometric average) is about 1.5. From data on comparable nonwarranted equipment for a slightly earlier period, an average ratio of about 0.3 was computed when field results were compared with reliability demonstration test results. Although the data are not entirely comparable, it appears that experience in the use of warranty for the equipments shown in Table 5-16 has been very favorable.

We will review the warranty/guarantee acquisition strategy of the Air Force's ARN-118 TACAN, since it involved all three approaches considered in this section. The acquisition program started with a feasibility study by two contractors to determine if a solid-state TACAN with a 1000-hour MTBF could be produced at a cost of $10,000 in lots of 500. The cost figure was about one-half of current TACANs and

TABLE 5-16

RIW EXPERIENCE: EXPECTED VS. FIELD MTBF

Equipment	Service	Contract Date	MTBF (Hours)		Ratio (Field/ Expected)
			Field	Expected	
Gyro	Navy	1967	531	520	1.02
Gyro	Air Force	1969	1,000	1,300	0.77
Pump	Navy	1973	1,100	600	1.82
VOR/ILS	Army	1974	800*	700**	1.14
Pump	Air Force	1975	8,500	5,000	1.69
TACAN	Air Force	1975	1,482	800**	1.85
Klystron	Air Force	1975	3,780	1,000	3.85
INS	Air Force	1975	1,261	1,090**	1.16
AHRS	Air Force	1975	2,943	1,285**	2.27
Omega	Air Force	1967	769	700**	1.10
Transmitter	Air Force	1977	310	238**	1.47
HUD	Air Force	1977	826	325**	2.56
LDNS	Army	1977	600	500**	1.20
			Geometric Average		1.53

*Estimated.
**Guaranteed.

the MTBF was about an order-of-magnitude improvement. Both contractors concluded that the objectives were feasible.

A competitive Full Scale Development phase was planned. The RFP included the $10,000 unit production price and 1000-hour MTBF as design goals. Two alternative approaches for reliability improvement and logistics support cost control were identified for the follow-on production contract. One was a logistics support cost commitment in which the contractors would "bid" parameters much as MTBF, MTTR, training costs, and spare parts cost. These parameters would be inserted into a model to obtain an estimate of 10-year costs – leading to the target life-cycle costs. The same parameters would then be measured on sample equipment in the field, and a measured life-cycle-cost value would be computed by use of the same model. A bonus/penalty formula would then be applied to the difference between the target value and the measured value.

The second approach in the development RFP was for the production contractor to provide a long-term warranty for contractor repair of all covered failures. As the development phase progressed, the Air Force decided to add an MTBF guarantee provision to the RIW.

To select between the two incentive approaches, LSCC and RIW/MTBF, the production RFP called for both contractors to price both alternatives. A life-cycle-cost model was used to estimate total ownership costs under each concept to provide one basis for choice. The contractors would then be asked to bid a "Best and Final Offer" for the selected warranty/guarantee approach.

Following through on this strategy, the Air Force chose the RIW/MTBFG option, since it had a slightly lower (about 6 percent) estimated ownership cost and a major application of RIW/MTBFG was desired.* A four-year warranty starting one year after initial delivery was selected. The MTBF guarantee was invoked, with a required MTBF value starting at 500 hours and "growing" to 800 hours in the last year of coverage.

Experience during the warranty period was very favorable, with excellent cooperation between the contractor and the Air Force in resolving problem issues. The measured field MTBF during the final measurement period was approximately 1500 hours, well above the requirement.

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5.15.12 Applicable Regulation

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*At about the same time, the LSCC approach was being tried with the procurement of the ARC-164 radio.

APPENDIX A

LIST OF ACRONYMS AND ABBREVIATIONS

AFR	Air Force Regulation
AFSARC	Air Force Systems Acquisition Review Council
AIP	Acquisition Improvement Program
AR	Army Regulation
ASARC	Army Systems Acquisition Review Council
ASD	Assistant Secretary of Defense
BES	Budget Estimate Submission
C^3I	Communications, Command, Control, and Intelligence
CAIG	Cost Analysis Improvement Group
CBO	Congressional Budget Office
CDR	Critical Design Review
CFE	Contractor Furnished Equipment
CID	Commercial Item Description
CPAF	Cost Plus Award Fee
CPFF	Cost Plus Fixed Fee
CPIF	Cost Plus Incentive Fee
CPM	Critical Path Method
C/SCSC	Cost/Schedule Control System Criteria
DAE	Defense Acquisition Executive
DAIP	DoD Acquisition Improvement Program
DAR	Defense Acquisition Regulation
DCP	Decision Coordinating Paper (originally entitled Development Concept Paper)
DID	Data Item Description
DNSARC	Department of the Navy Systems Acquisition Review Council
DoD	Department of Defense
DODD	Department of Defense Directive
DODI	Department of Defense Instruction
DRB	Defense Resources Board
DSARC	Defense Systems Acquisition Review Council
DSB	Defense Science Board
DSMC	Defense Systems Management College
DTC	Design-to-Cost
DTUPC	Design-to-Unit Production Cost
ECP	Engineering Change Proposal
EPA	Extended Planning Annex
FAR	Federal Acquisition Regulation
FCA	Functional Configuration Audit
FFP	Firm Fixed Price
FPIF	Fixed Price Incentive Fee
FQR	Formal Qualification Review
FRACAS	Failure Reporting and Corrective Action System
FSD	Full Scale Development
FYDP	Five-Year Defense Program
GAO	General Accounting Office
GFE	Government Furnished Equipment
GOCO	Government-Owned Contractor-Operated
HAC	House Appropriations Committee
HASC	House Armed Services Committee
HBC	House Budget Committee
ICA	Independent Cost Analysis
IPS	Integrated Program Summary
ILSP	Integrated Logistics Support Plan
IOC	Initial Operational Capability
JCS	Joint Chiefs of Staff
JMSNS	Justification for Major System New Start

LCC	Life-Cycle Cost
LRIP	Low Rate Initial Production
M&RA	Manpower and Reserve Affairs
MIS	Management Information System
MRA&L	Manpower, Reserve Affairs, and Logistics
MTBF	Mean Time Between Failure
MYP	Multiyear Procurement
NATO	North Atlantic Treaty Organization
OFPP	Office of Federal Procurement Policy
OMB	Office of Management and Budget
OSD	Office of the Secretary of Defense
P^{3}I	Pre-Planned Product Improvement
PDM	Program Decision Memorandum
PDR	Preliminary Design Review
PEP	Producibility Engineering and Planning
PERT	Program Evaluation and Review Technique
PI	Product Improvement
PM	Program Manager
PMO	Program Management Office
POM	Program Objectives Memorandum
PPBS	Planning, Programming, and Budgeting System
PPI	Planned Product Improvement
RDT&E	Research, Development, Test, and Evaluation
RFP	Request for Proposal
RIE	Range of Incentive Effectiveness
RIW	Reliability Improvement Warranty
RSI	Rationalization, Standardization, and Interoperability
SAR	Selected Acquisition Report
SAC	Senate Appropriations Committee
SASC	Senate Armed Services Committee
SBC	Senate Budget Committee
SCP	System Concept Paper
SDDM	Secretary of Defense Decision Memorandum
SecDef	Secretary of Defense
SEMP	Systems Engineering Management Plan
SSP	System Support Package
T&E	Test and Evaluation
TAAF	Test, Analyze, and Fix
TEMP	Test and Evaluation Master Plan
TOA	Total Obligational Authority
TRACE	Total Risk Assessing Cost Estimate
USDP	Under Secretary of Defense, Policy
USDRE	Under Secretary of Defense for Research and Engineering
VERT	Venture Evaluation and Review Technique
WBS	Work Breakdown Structure

APPENDIX B

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INDEX

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UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION: UNCLASSIFIED

1b. RESTRICTIVE MARKINGS:

2a. SECURITY CLASSIFICATION AUTHORITY:

2b. DECLASSIFICATION/DOWNGRADING SCHEDULE:

3. DISTRIBUTION/AVAILABILITY OF REPORT: Unlimited

4. PERFORMING ORGANIZATION REPORT NUMBER(S):

5. MONITORING ORGANIZATION REPORT NUMBER(S):

6a. NAME OF PERFORMING ORGANIZATION: ARINC Research Corporation

6b. OFFICE SYMBOL (If applicable):

7a. NAME OF MONITORING ORGANIZATION: Defense Systems Management College

6c. ADDRESS (City, State and ZIP Code): 2551 Riva Road, Annapolis, MD 21401

7b. ADDRESS (City, State and ZIP Code): Fort Belvoir, VA 22060-5426

8a. NAME OF FUNDING/SPONSORING ORGANIZATION:

8b. OFFICE SYMBOL (If applicable):

9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER: MDA903-82-G-0056

8c. ADDRESS (City, State and ZIP Code):

10. SOURCE OF FUNDING NOS.

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT NO.
		83-6	

11. TITLE (Include Security Classification): Acquisition Strategy Guide

12. PERSONAL AUTHOR(S): Dr. J. R. Nelson, Dr. Harold S. Balaban

13a. TYPE OF REPORT:

13b. TIME COVERED: FROM ______ TO ______

14. DATE OF REPORT (Yr., Mo., Day): 84 July 1

15. PAGE COUNT: 168 plus covers

16. SUPPLEMENTARY NOTATION:

17. COSATI CODES

FIELD	GROUP	SUB. GR.

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number): Acquisition Strategy, Major Systems Acquisition, Acquisition Planning, Program Management Plans, Program Planning

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

Department of Defense policy requires that military Program Managers develop a tailored acquisition strategy that will provide the conceptual basis of the overall plan that a Program Manager follows in program execution. A strategy that is carefully developed and consistently executed is one of the keys to a successful program. It is a difficult and challenging task to blend the multitude of requirements for a major system acquisition into an acquisition strategy that represents a consensus among the organizations that influence or are influenced by the program.

The challenges in developing and executing an acquisition strategy have led to the development of the acquisition strategy guide. The purpose of the guide is to provide the program manager a framework for developing and executing an acquisition strategy. Criteria for evaluating an acquisition strategy are described and developed. Many of the strategy alternatives available to a program manager are described including advantages and disadvantages, application criteria, functional interfaces and recent program experience.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT: UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS ☐

21. ABSTRACT SECURITY CLASSIFICATION:

22a. NAME OF RESPONSIBLE INDIVIDUAL:

22b. TELEPHONE NUMBER (Include Area Code):

22c. OFFICE SYMBOL:

DD FORM 1473, 83 APR — EDITION OF 1 JAN 73 IS OBSOLETE

SECURITY CLASSIFICATION OF THIS PAGE

Comment Sheet
for
Acquisition Strategy Guide

This guide was prepared as a working reference document for program management personnel. The multitude of consideration required in the creation of an acquisition strategy necessitated careful selection of the topics covered. A major consideration during the preparation of possible subsequent editions will be the comments, criticisms and suggestions of you in the program management community. Use the space below to let the editors know how you think the handbook can be improved (e.g., recommended additions, deletions, corrections, or other suggestions). Attach additional sheets as necessary.

Whether or not you have comments or suggestions for future editions, we are very interested in your reaction to our efforts on this handbook. Please take a few moments to identify its strengths and weaknesses. In each box, enter a number rating as follows: 1-Excellent; 2-Good; 3-Fair; 4-Poor.

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